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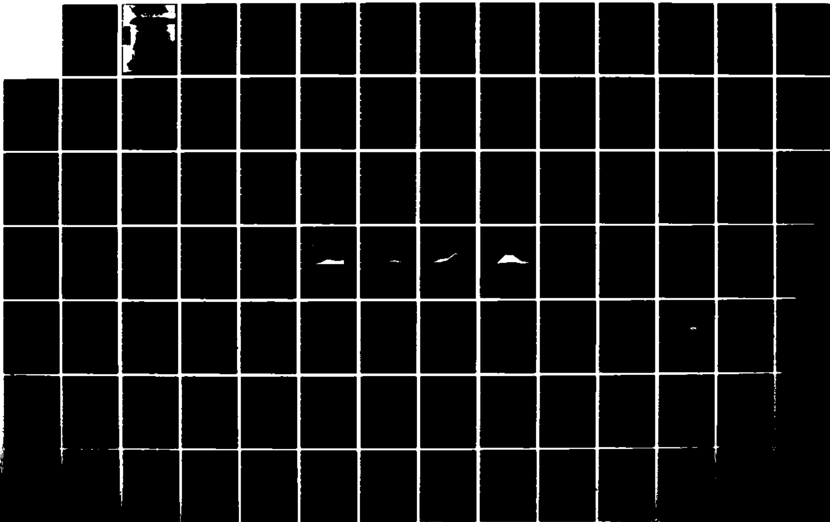

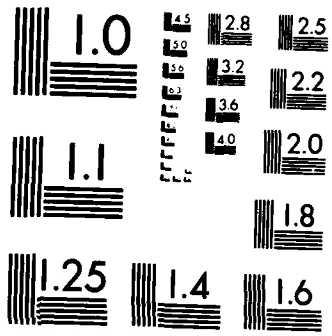
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MAY 1984

FINAL REPORT

PREPARED FOR

ARMY ENGINEER DISTRICT, MOBILE

MOBILE, ALABAMA

36628

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West Point Reservoir on the Chattahoochee River was impounded by a Corps of Engineers dam located 3.2 miles north of West Point, GA. Fishery and limnological studies funded by the Corps began in February 1976 to (a) document changes in the physical, chemical, and biological characteristics of West Point Lake over a period of years with emphasis on detection of those factors contributing to the expected decline in sport fishing success, and (b) implement and evaluate fishery management practices aimed at improving the catch per unit of effort of sport fisherman. Limnological data collected between October 1979

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and Septermber 1980 indicate that the decline in photoplankton standing crop for the lake continued a trend that began the first sampling year (1976-1977). The decline continues to result from fewer numbers of yellow-green algae. Primary productivity annual mean was 559.4 mg C/M^2/day which was the lowest measured for the reservoir to date. This decline was not statistically significant but may represent a trend toward decreasing productivity. Mean total organic carbon varied little throughout the lake, but was the lowest measured to date which may represent additional evidence of productivity decline. Species diversity and equitability of zooplankton communities did not differ significantly from that reported the previous year. Observations on coverage and abundance of the most common aquatic macrophytes in the lake, alligatorweed and smartweed, indicate a reduction in their prevalence. Comparison of the water quality and limnological characteristics of the Wehadkee Creek and Yellow Jacket Creek areas of the reservoir revealed that both maintained favorable environmental conditions to support healthy fish communities. The black crappie is the most important sport fishery on the lake as measured by total directed effort. The striped-white bass hybrid fishery is developing as additional fish are stocked each year by Georgia's Department of Natural Resources.

COESAM/PD-EE-84/001

(1)

FINAL REPORT

Fisheries and Limnological Studies on West Point Lake Alabama-Georgia

(Contract No. DACW01-78-C-0082)
Modification No. 2
October 1979-September 1980
Phase IV

Submitted to

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PREFACE

This report presents the results of the fisheries and limnological studies on West Point Lake, Alabama-Georgia, from October 1979 through September 1980 with some unreported data covering previous report periods. The investigation was conducted under Contract No. DACW01-78-C-0082 to the Department of Fisheries and Allied Aquacultures, Auburn University, Alabama from the U.S. Army Corps of Engineers, Mobile District.

Personnel of the Alabama Department of Conservation and Natural Resources, Georgia Department of Natural Resources, U.S. Fish and Wildlife Service are acknowledged for their aid and cooperation in various facets of the study and their agencies as cooperators on the project.

The report was written by W. D. Davies, W. L. Shelton and S. P. Malvestuto (fisheries), D. R. Bayne (limnology) and J. M. Lawrence (water chemistry). The following individuals are acknowledged for their assistance in the study: M. Hale, B. Ciliax, W. Seesock, R. Scully, G. Lucas, R. Ott, A. Sonski, S. Miranda, and M. Hudgins.

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EXECUTIVE SUMMARY

1. This report presents the results of the fisheries and limnological studies conducted on West Point Lake from October 1979 through September 1980. It is a continuation of the studies designed to document changes in the physical, chemical and biological characteristics of a new impoundment (West Point Lake) over a ten-year period. Study objectives were designed to emphasize detection of those factors contributing to an expected decline in sport fishing success. Additionally, under a separate contract with the U.S. Army Corps of Engineers, Mobile District, the Department of Fisheries and Allied Aquacultures, Auburn University, agreed to gather certain chemical data should anaerobic conditions develop in West Point Lake during the late summer of 1980.

2. Limnological data collected during the period of 1 October 1979 through 30 September 1980 consisted of the following variables: phyto- and zooplankton abundance and taxonomic composition; primary productivity; carbon analyses including total organic carbon, suspended organic matter and total carbon; chlorophyll concentrations of lake waters; aquatic macrophyte abundance and distribution; and benthic macroinvertebrate abundance and taxonomic composition. Sampling design included temporal and spatial sampling to provide information that was representative of the entire lake during each season of the year.

3. Fishery studies involved sampling fish populations and estimating catch and effort statistics associated with the sport fishery. Fish population sampling included electrofishing, toxicants and netting. These sample data provided estimates of fish population characteristics (i.e., size and age structure). A roving creel survey employing non-uniform probability for selecting sample time and locations was used to provide relatively precise and unbiased estimates. Detailed life history of the largemouth bass included reproductive and food habit studies.

4. Estimated mean phytoplankton densities varied from a low of 181 organisms/ml at station A in February 1980 to a high of 3,698 organisms/ml at station D in August 1980. Chlorophyll _a_ concentrations ranged from 0.0 to 25 mg/m^3 with a mean for the lake of 9.63 mg/m^3. The decline in phytoplankton standing crop for the lake continued a trend that began after the first sampling year (1976-77). The decline in abundance of phytoplankton resulted from fewer numbers of yellow-green algae.

5. Yellow-green algae (Chrysophyta) numerically dominated phytoplankton samples at all mainstream stations on any given date. For the lake as a whole, yellow-green algae dominated samples on three of the four sample dates. Green algae (Chlorophyta) ranked second in abundance except for the May sample when blue-green algae (Cyanophyta) were more abundant. Dominant species included various pennate and

centric diatoms like Melosira granulata and M. varians; the green coccoids Ankistrodesmus convolutus and Scenedesmus quadricauda along with the green flagellate Chlamydomonas spp.; Oscillatoria angustissima was the dominant blue-green alga. There have been no significant shifts in dominant algal forms during the last five years.

6. Quarterly estimates of mean primary productivity in West Point Lake ranged from a low of 79 mg C/m^2/day in December 1979 to a high of 1,161 mg C/m^2/day in September 1980. Estimated annual mean primary productivity was 559.4 mg C/m^2/day. This annual estimate for the reservoir was the lowest measured to date. Although the decline in primary productivity was not statistically significant ($P > 0.05$) it may represent a trend toward decreasing productivity as the lake ages.

7. Based on suspended organic matter (SOM) analyses, allochthonous organic loading of reservoir headwaters was common. Analyses of SOM from previous years' research have revealed the same trends. Mean total organic carbon (TOC) varied little throughout the lake. Highest TOC concentrations were in September and August reflecting high standing crops of phytoplankton during these months. Mean TOC concentrations for the lake were the lowest measured to date which may represent additional evidence of a gradual decline in productivity.

8. Mean zooplankton density for the year varied from 6 organisms/l at station A in the headwaters of the lake to 281 organisms/l at station G in Yellowjacket Creek. Mean density was highest in May and October and lowest in August and February. The low abundance obtained in August was unexpected since zooplankton populations are usually relatively dense during this period. This dropoff in density occurred throughout the reservoir due to the low numbers of rotifers collected in samples. Annual mean zooplankton densities (total zooplankton including immature copepods) during the last four years were 292, 261, 119 and 192 organisms/l for 1976-77, 1977-78, 1978-79 and 1979-80, respectively. Limnetic zooplankton communities were again dominated by rotifers. One of three species of rotifers (Keratella cochlearis, Conochilus unicornis, or Trichocera cylindrica) usually dominated zooplankton communities on most dates. Nauplii were the dominate copepods and Bosmina longirostris was the dominant cladoceran. Species diversity and equitability of zooplankton communities did not differ significantly from that reported the previous year.

9. Observations on coverage and abundance of the most common aquatic macrophytes in the lake, alligatorweed and smartweed, indicated a reduction in their prevalence. This reduction may have resulted from the progressive lowering of the water level during the growing season.

10. Benthic macroinvertebrate standing crops collected from dredge samples in the littoral areas of the lake contained a total of 92 identifiable taxa. Sixty-two of these taxa were members of one insect family, Chironomidae. Aquatic earthworms (oligochaetes) and midge larvae (Chironomidae) usually dominated numerically on most dates. A

total of 89 taxa were identified from the Hester-Dendy multiple plate samplers used in the littoral and sublittoral areas of the lake. Sixty-one of these taxa were members of the Chironomidae. Cladocerans (water fleas) and chironomids usually dominated plate sampler collections. Macroinvertebrate density from plate sampler collections was significantly less ($P < 0.05$) than that from the previous year. The April 1980 plate samples were unusually low at all stations due in part to environmental conditions.

11. A comparison of the water quality and limnological characteristics of the Wehadkee Creek and Yellowjacket Creek areas of the reservoir revealed that both maintained favorable environmental conditions to support healthy fish communities. Primary productivity and fish-food organism density were similar to each other and nearby areas of the lake.

12. Results of the water quality study under anaerobic conditions in West Point Lake are shown in Appendix B. Since dissolved oxygen concentrations on the three sampling dates never dropped below 1.0 mg/l, anaerobic sampling was unnecessary.

13. The total estimated standing stock of fish from cove rotenone sampling in 1980 ranged from a low of 177 kg/ha to a high of 616 kg/ha (mean standing stock = 320 kg/ha). A relatively large number of species comprise the fish community, but only three had E values greater than 10% (bluegill, carp and gizzard shad). There has been no significant decline in total fish biomass; however largemouth bass continue to occupy only a small portion of total fish biomass (approx. 2.5%).

14. The black crappie is the most important sport fishery on the lake as measured by total directed effort. Recruitment of age 0 fish continued to increase from 1976 where no measurable recruitment occurred. The strong 1975 year class of crappie has for the most part disappeared from the creel.

15. The striped-white bass hybrid fishery is developing as additional fish are stocked each year by Georgia's Department of Natural Resources. The months of July, August and September are best; anglers fish late afternoon and early morning in areas adjacent to the old river channel.

16. A conceptual model depicting recruitment dependent prey relationships formed the basis for recommending a management strategy that would restrict the harvest of largemouth bass (i.e., reduce fishing mortality). As a result bass would accumulate in the system providing greater predatory pressure on the abundant (but slow growing) prey species. The end result would be an increase in bass production, and ultimately better fishing.

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Appendix A

Appendix B

CONVERSION FACTORS, U.S. TO METRIC (SI) UNITS OF MEASUREMENT

U.S. customary units of measurement used in this paper can be converted to metric (SI) units as follows:

Multiply	By	To obtain
inches	25.4	millimeters
feet	0.3048	meters
miles	1.609344	kilometers
square miles	2.58999	square kilometers
acres	0.40468	hectares
acres	0.0040468	square kilometers
pounds	453.5923	grams
pounds per acre	1.120851	kilograms per hectare
number per acre	2.47	number per hectare

INTRODUCTION

1. The present report covers the period October 1979 through September 1980 (Phase IV) and represents a continuation of the Phase III report (Shelton et al. 1981). The format established in the previous report has been maintained for continuity of the overall project which emphasized the biological and limnological interrelationships of a new impoundment; data not discussed fully in Phase III are included here for completeness. Additionally, under a separate contract with the Corps, the Department of Fisheries and Allied Aquacultures, Auburn University, agreed to gather certain chemical data in West Point Lake during the late summer of 1980. This data was to be collected at stations where anaerobic conditions were found.

2. The West Point Lake on the Chattahoochee River was impounded by a U.S. Army Corps of Engineers dam located 5.15 kilometers (km) north of West Point, Georgia at Chattahoochee River mile 201. The reservoir has a total drainage area of 8,745 km^2 and a surface area of 10,467 hectares (ha) at the normal pool elevation of 194 meters (m) above mean sea level (msl) (U.S. Army Engineers 1963).

3. The Chattahoochee River originates in the Blue Ridge Mountains of north Georgia and flows southwesterly through the Piedmont province to West Point. Metamorphic and igneous rock form the substrata of the Piedmont, and the waters of this area are generally soft and low in mineral content (Whitlatch 1964). The runoff from the upper third of the drainage area is controlled by Lake Sidney Lanier. Some 48 km downstream from Lake Sidney Lanier and 112 km upstream from West Point Lake, the Chattahoochee River receives the treated domestic and industrial effluents from over 50 percent of metropolitan Atlanta. Throughout the basin there is a rather high rate of soil erosion which is largely the result of construction and agricultural practices.

4. When the lake was in the planning stage, the water quality in the Chattahoochee River below Atlanta was in a degraded condition. Thus, much concern was expressed about the excessive organic, nutrient, and pathogenic organism loading that would enter West Point Lake. In the interim between planning and the existence of this impoundment an extensive waste treatment program was implemented in this region of Georgia. Organics, pathogenic organisms, and nutrient loading were greatly reduced.

5. The area that was inundated to form West Point Lake was cleared of trees, stumps and debris between elevation 183 and 194 m msl. Trees below the 183 m level were topped at elevation 189 m msl as the lake was filled. West Point Lake started filling in the fall of 1974, and by mid-November it had reached an elevation of approximately 188 m msl. The lake was held at this level for approximately 5 months while the topping operation on some 1,538 ha of standing timber was completed.

6. Full power pool elevation of 193 m msl was attained in early June, 1975. Normal operations are to maintain this water level until November and then lower to the winter pool of 190 m msl. The lake remains at this lower level until May and is then allowed to fill back to the summer pool elevation of 193 m msl. Additional discussion of the lake and watershed is found in the West Point Fish Management Plan (U.S. Army Engineers 1975) and the Environmental Impact Statement (U.S. Army Engineers 1977).

7. The reservoirs of the southeastern United States provide abundant recreational opportunities. In this resepct newly impounded reservoirs provide exceptional fishing, especially for carnivorous species such as the largemough bass and crappie. However, within a few years, catch per effort reportedly declines (Bennett 1971). Jenkins and Morais (1971) analyzed data from reservoirs and found that the age of an impoundment, area and growing season were the most significant factors of 10 environmental variables tested that correlated with angler harvest. Chance et al. (1975) discussed the decline in bass harvest over a 7-year period in the first decade of Norris Reservoir. The explanation for this boom-and-bust sequence is not fully understood; however, numerous contributing factors have been suggested (Cahn 1937, Eschmeyer and Tarzwell 1941, Tarzwell 1942, Kimsey 1958, Stroud 1968, Poddubny 1971). The filling of a new reservoir presents a vast new area of unoccupied space. Inundated trees and stumps provide many new areas of cover and the flooding of rich bottom land contributes to the fertility of the water. The conditions are suited for rapid population expansion into the increased living space, new niches and an abundance of food. For example, large numbers of bass are usually hatched and recruited in a newly impounded reservoir. At this time a large percentage of the forage is of a size that can readily be eaten by yearling bass. As a result, growth and survival are excellent. Eventually as a greater percentage of the fish biomass is composed of adult fishes, recruitment of bass is suppressed which is later reflected in a decline in catch per effort. Prolonged leaching of nutrients from bottom soils may decrease fertility of the water and reduce primary production within the ecosystem. But this relationship may be affected by the high rate of flow-through in mainstream reservoirs (Shelton et al. 1981). Because of the scarcity of reliable observations on the dynamics of expanding reservoir fish populations and relationships between nutrient levels and fish-food organism production, no effective management plan has emerged to circumvent the decline in fishing success.

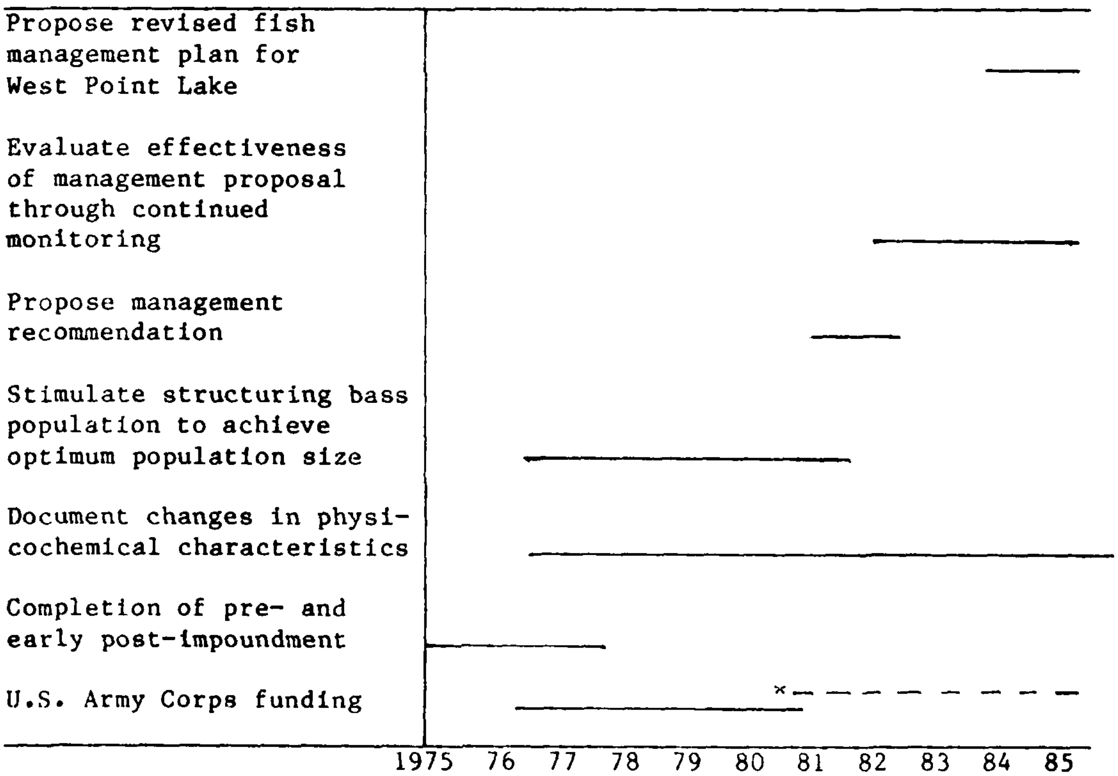
8. The impounding of the Chattahoochee River to form the West Point Lake has offered an excellent opportunity to document the changes that take place in expanding fish populations and evaluate proposed management input. These data can readily be related to the biological and chemical information available from existing preimpoundment surveys (Chookajorn 1973, Hiranvat 1973, Shelton 1974, Lawrence 1975). Aquatic studies on the Chattahoochee River have been conducted by Auburn

University personnel since the mid-sixties (Bayne 1967, Rawson 1969, Gilbert 1969, Lawrence 1971, Morris 1973, Keller 1973, Lawrence 1974, Davies and Shelton 1976). A preimpoundment fishery survey of the West Point Lake watershed was initiated in January 1972. The survey determined the species composition, age, growth and reproductive condition of major species and the standing stocks of stream populations.

9. West Point Lake is receiving substantial fishing and other recreational pressure due to its proximity to population centers such as Atlanta and LaGrange, Georgia. West Point Lake can be used as a model of recreational management in which fishing is an integral and major component.

10. Study objectives include: 1) documenting changes in the physical, chemical and biological characteristics of West Point Lake with emphasis on detection of those factors contributing to the expected decline in sport fishing success, and 2) implementing and evaluating fishery management practices aimed at improving the catch per effort of sport fishermen.

11. The following schedule illustrates past activities and the expected sequence of planned events:



*End of present reporting period.

METHODS AND DESIGN

Limnological Studies

Plankton

12. The objective of this phase of the study was to identify and quantify the plankton community at each sample station in the lake. Data collected from the various depths sampled at each location were averaged to obtain station means. In addition, the numerically dominant plankters were determined from composite samples of all depths at that location. Plankton samples were collected quarterly using a submersible plastic water pump and hose apparatus. The locations and depths sampled appear in Table 1 and Figures 1 and 2. Discrete depths were sampled at each station to adequately characterize the plankton community at that location in the lake. The vertical migrations typical of plankton necessitated this approach (Weber 1973).

Phytoplankton

13. The phytoplankton sample at each station and depth consisted of 500 ml of water measured into a flat-bottom, one liter Nalgene bottle containing a merthiolate preservative (Weber 1973). These samples were transported to the laboratory, allowed to settle at least 24 hours and concentrated by siphoning off most of the water.

14. Enumeration was accomplished in a Sedgwick-Rafter counting cell using a one milliliter aliquot taken from the well mixed concentrate. Both field and strip counts were used depending on the concentration of phytoplankton (APHA 1980). However, only one type of count was used for all depths at a particular station. Phytoplankters were counted and reported by taxonomic group. The groups included:

Chrysophyta	Chlorophyta	Cyanophyta	Others
Diatoms	Green algae	Blue-green algae	Other
centric	coccoids	colonial	pigmented
pennate	filamentous	filamentous	flagellates

When filamentous fragments were encountered they were counted as whole organisms if complete cells were present. The counts for each depth at a particular station were averaged to obtain the station means.

15. In addition to enumeration, those phytoplankters that were numerically dominant in composite samples from each station were identified to species where possible. Taxonomic references used were Smith (1950), Cocke (1967), Prescott (1970), Weber (1971) and Whitford and Schumacher (1973).

Table 1

Description of sample stations in West Point Lake for plankton and water samples, 1979-80.

Station	Location	Depths (m) for plankton sampling
A	Chattahoochee River, Franklin, GA	0[1], 2
B	GA Hwy 219 Bridge	0, 2, 4
C	GA Hwy 701 Bridge	0, 2, 4
D	300 m above West Point Dam	0, 2, 4, 8
E	300 m below West Point Dam	0
F	Wehadkee Cr. above AL Hwy 701 Bridge	0, 2 ,4
G	Yellowjacket Cr. above Wares Road Bridge	0, 2, 4

[1] 0 m is between water surface and 0.1 m depth.

Zooplankton

16. The zooplankton community was sampled at each station and depth by pumping at least 40 liters of water through an 80 μ mesh Wisconsin style plankton net. Organisms were concentrated by washing them from the plankton bucket into 100 ml Nalgene bottles and preserving in 5% formalin.

17. Zooplankters were enumerated and identified in a Sedgwick-Rafter counting cell. A one milliliter aliquot of each well-mixed sample was used for analysis. To provide a statistically valid count at least 100 organisms were counted from each sample. The counts for each depth at a particular station were averaged to obtain station means. Where feasible zooplankters were identified to genus and species. Taxonomic references used were Ahlstrom (1940), Hauer (1953), Edmondson (1959), Sudzuki (1964), Pourriot (1965), Ruttner-Kolisko (1974) and Pennak (1978). Additionally, the two numerically dominant zooplankters were identified plus the three dominant taxa within each major group (rotifers, copepods, cladocerans) were identified for each station.

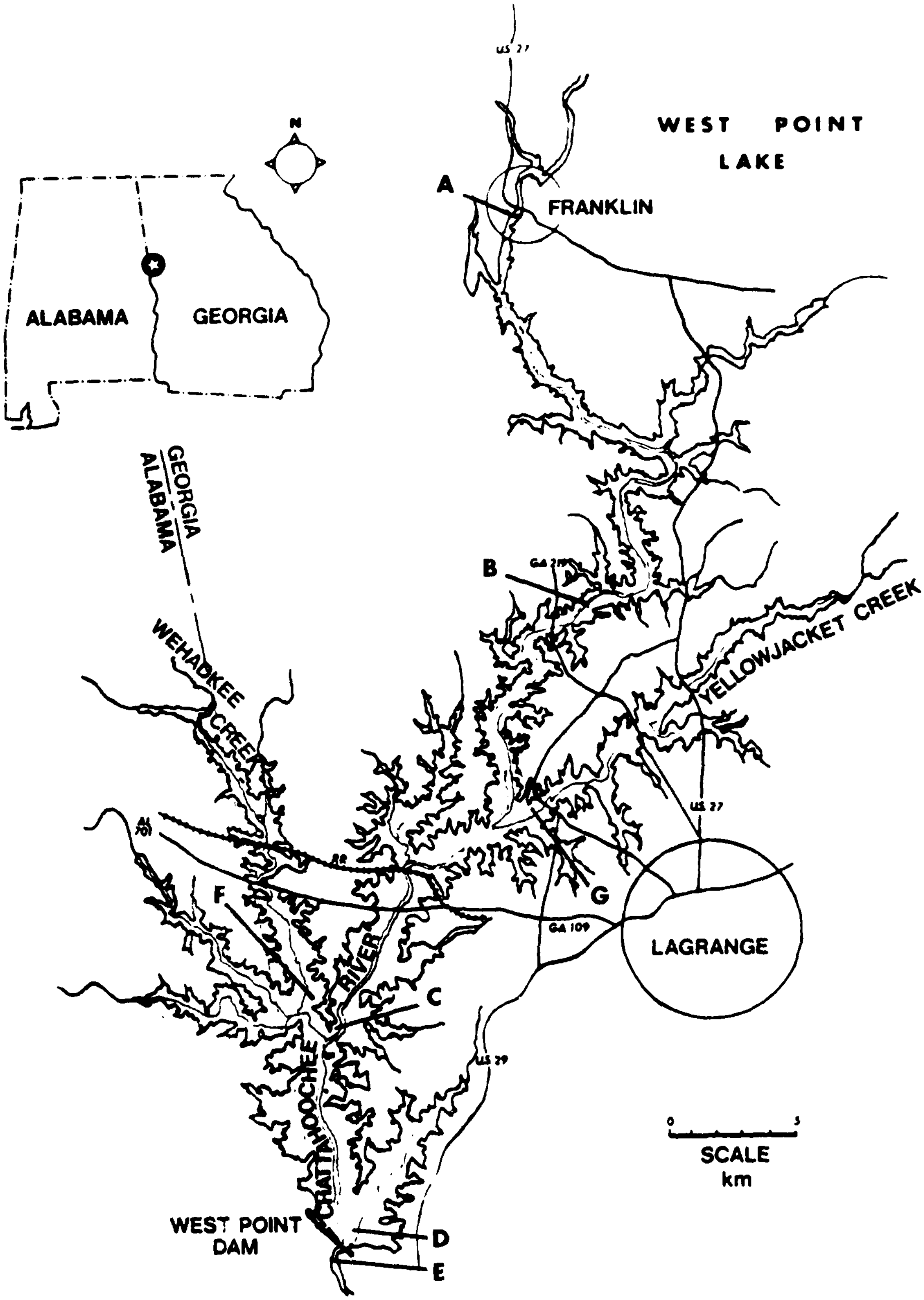


Figure 1. Map of West Point Lake with locations of limnological sampling stations.

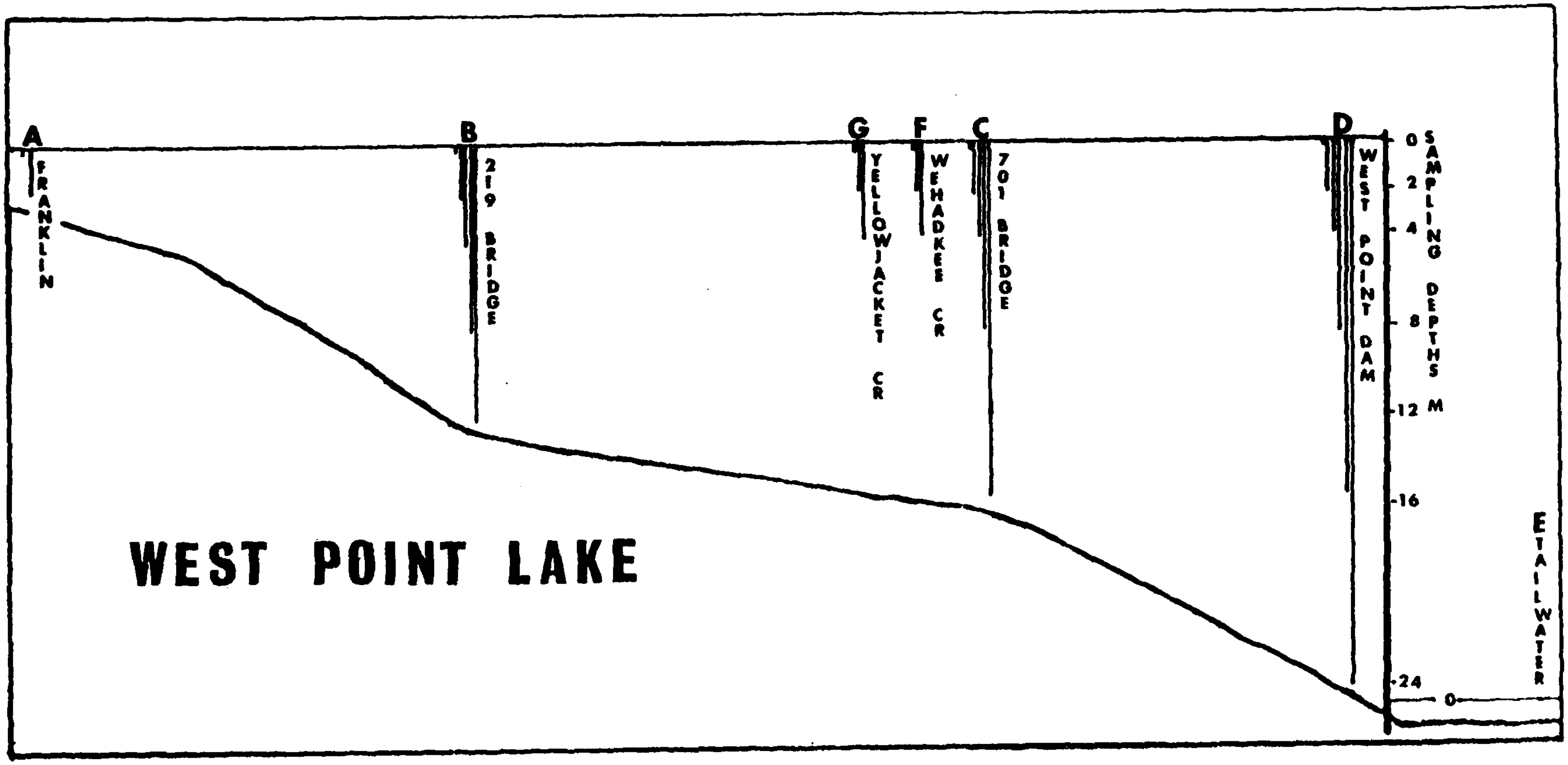


Figure 2. Sampling depth profile of each station in West Point Lake.

18. Diversity ($\bar{d}$) and equitability (e) of zooplankton communities at each station were calculated (excluding immature copepods) as recommended by Weber (1973). Annual means for zooplankton density, number of taxa, taxa diversity and equitability for the four sampling years (1976-77, 1977-78, 1978-79, 1979-80) were tested for significant differences ($\alpha = 0.05$) using the student's t test (Steel and Torrie 1960).

Chlorophyll

19. Water samples for chlorophyll analysis were collected at six week intervals (Table 2). The stations and depths sampled were the same as those for plankton (Figure 1 and 2). Water samples were pumped into 2 liter Nalgene containers, cooled and returned to the laboratory where the suspended matter was filtered onto 0.45 pore size millipore filters. The trichromatic method used to measure and calculate chlorophylls a, b and c followed Standard Methods (APHA 1980). Chlorophyll values were calculated on a volume basis (mg/m^3) and an areal basis (mg/m^2). Chlorophyll quantities expressed on an areal basis were useful in comparing one area of the lake with another. This was particularly true in a reservoir like West Point Lake since flow patterns result in a photic zone with a highly variable depth. The method used to calculate chlorophyll values on an areal basis at each station consisted of the following computations:

Depths Sampled (m)	Chlorophyll (mg/m^2)	Computations
0	C_1	
1	C_2	$(C_1+C_2)/2$ x Depth Interval = X C_1-C_2
2	C_3	$(C_2+C_3)/2$ x Depth Interval = X C_2-C_3
4	C_4	$(C_3+C_4)/2$ x Depth Interval = X C_3-C_4
8	C_5	$(C_4+C_5)/2$ x Depth Interval = X C_4-C_5
		C_x = mg chlorophyll/m^2

Chlorophyll values calculated on a volume basis (mg/m^3) at each station were averages of all depths sampled at that location.

Table 2

Dates, stations and depths from which water samples were collected from West Point Lake between 1 October 1979 and 30 September 1980

Date	Station and depth (m) sampled						
	A	B	C	D	E	F	G
10-17-79*	0**-2	0-2-4-8-12	0-2-4-8-16	0-2-4-8-16-24	0	0-2-4	0-2-4
12- 5-79	0-2	0-2-4-8-12	0-2-4-8-16	0-2-4-8-16-24	0	0-2-4	0-2-4
2-12-80*	0-2	0-2-4-8-12	0-2-4-8-16	0-2-4-8-16-24	0	0-2-4	0-2-4
3-19-80	0-2	0-2-4-8-12	0-2-4-8-16	0-2-4-8-16-24	0	0-2-4	0-2-4
5- 9-80*	0-2	0-2-4-8-12	0-2-4-8-16	0-2-4-8-16-24	0	0-2-4	0-2-4
6- 5-80	0-2	0-2-4-8-12	0-2-4-8-16	0-2-4-8-16-24	0	0-2-4	0-2-4
8- 5-80*	0-2	0-2-4-8-12	0-2-4-8-16	0-2-4-8-16-24	0	0-2-4	0-2-4
9- 4-80	0-2	0-2-4-8-12	0-2-4-8-16	0-2-4-8-16-24	0	0-2-4	0-2-4

*Dates on which plankton samples were taken
** 0 = depth between water surface and 0.1 m depth.

Primary Productivity

20. The carbon-14 method of estimating primary productivity was used (APHA 1980). Duplicate light and dark bottles were incubated for three hours at each of three depths within the photic zone at six locations within the reservoir (Figure 3). The lower limit of the photic zone was defined by multiplying the Secchi disc visibility by a factor of four (Taylor 1971a). Bottles were incubated at the lower limit of the photic zone, midway between the lower limit and the surface and just below the surface. The study was repeated for three consecutive days in December 1979 and March, June and September, 1980.

21. Productivity was calculated and reported as mg C/m^2/day. Mean productivity values for the three days were extrapolated to quarterly estimates based on total solar radiation measured during the quarter (Appendix A, Table 1). This was accomplished by multiplying the mean productivity for three days by the total solar radiation (Langleys) measured during the quarter (Appendix A, Table 1) and dividing by the average daily radiation measured during the three day sample (Taylor 1971a). The quotient was then divided by the number of days in the quarter. The Duncan's Multiple Range Test (Steel and Torrie 1960) was used to detect differences in seasonal and station means ($\alpha = 0.05$).

Organic Matter and Carbon

22. Organic Content of Suspended Matter. Water samples were collected on 8 dates between 1 October 1979 and 30 September 1980 (Table 2). All water samples were collected with a submersible plastic water pump and hose apparatus, stored in two liter Nalgene plastic containers, cooled and returned to the laboratory at Auburn University, Auburn, Alabama. Estimates of total suspended matter dry weight and organic content were made on all water samples collected. Reservoir waters were filtered through Gelman A-E glass fiber filters for total suspended residue and organic matter determinations. Analytical procedures used for measuring total suspended matter and the fixed residue (organic matter) were those in Standard Methods (APHA 1980).

23. Total Carbon (TC). Total carbon was measured on water samples collected during 1979-80 (Table 2). Analytical techniques included use of a total carbon analyzer (the combustion infrared method) following procedures in Standard Methods (APHA 1980).

24. Total Organic Carbon (TOC). Total organic carbon was measured on water samples collected during 1979-80 (Table 2). Analytical procedures used included use of a total carbon analyzer following techniques in Standard Methods (APHA 1980).

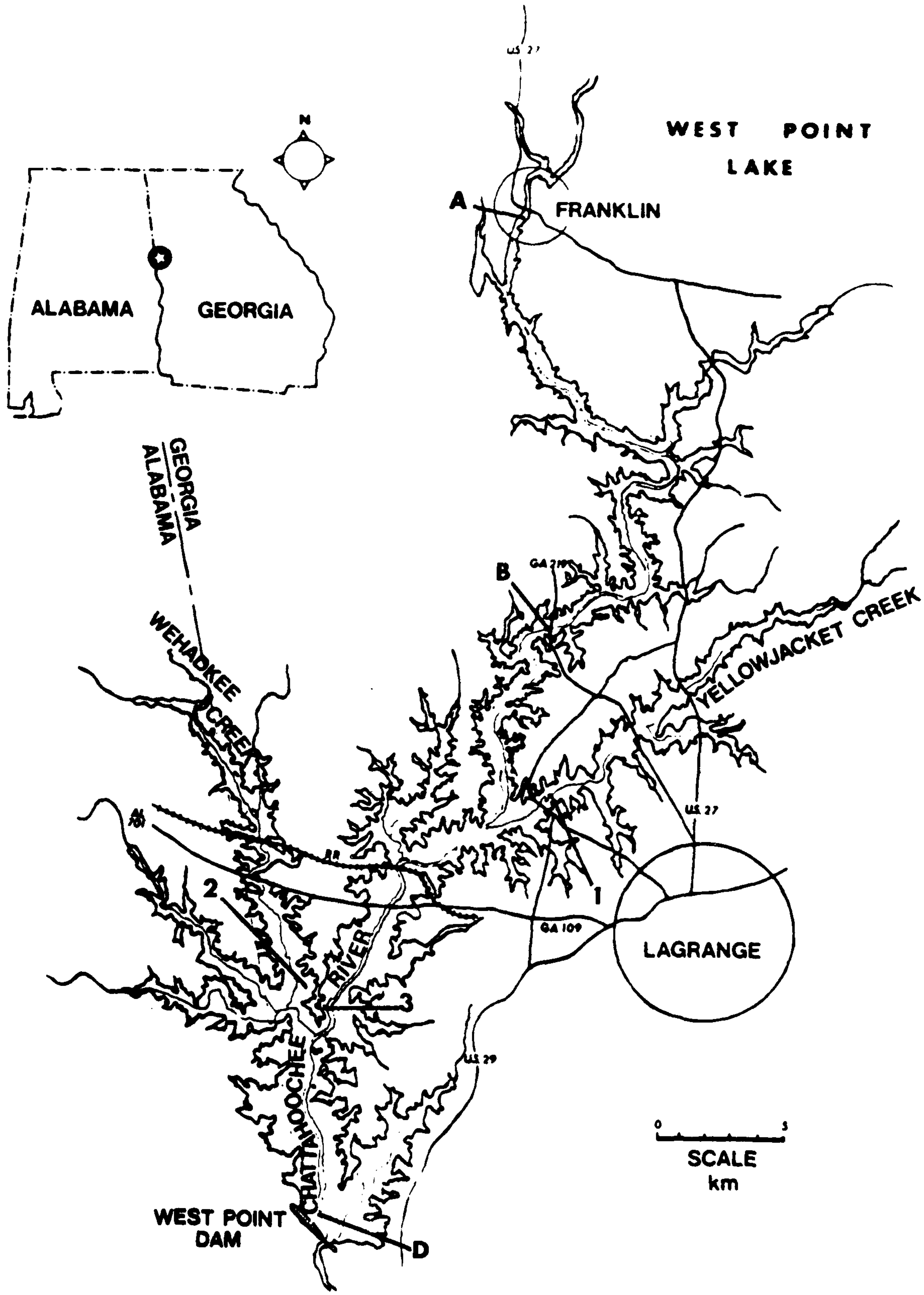


Figure 3. Primary productivity sample stations.

Aquatic Macrophytes

25. The distribution and estimated abundance of aquatic macrophytes were determined by visual observation of shoreline and shallow water areas during the growing season of 1979-80.

Benthic Macroinvertebrates

26. The benthic macroinvertebrate fauna in West Point Lake was sampled with bottom grabs (dredge samples) and artificial substrates (Hester-Dendy multiple plate samplers). Dates for collecting the bottom samples and setting the artificial substrates were the following:

Grab Samples	Artificial Substrates
6 September 1979	4 October 1979
7 December 1979	3 January 1980
19 March 1980	16 April 1980
6 June 1980	1 July 1980

27. Grab samples were collected with a Ponar dredge (23 x 23 cm) at 12 stations in the littoral zone of the lake (Figure 4). Sampling was confined to the contour interval where the water level was 0.3-0.9 meters deep. Duplicate samples were collected at each station and each sample was analyzed separately. Bottom materials were washed through a U.S. Standard No. 30 sieve (pore size 0.59 mm), preserved in 5-10% formalin and returned to the laboratory (Weber 1973). Samples were placed in a saturated salt solution to float organisms free from the sediment and debris. The organisms were transferred back into 5% formalin containing rose bengal, a stain selective for tissues. The stain facilitated sorting and removal of the invertebrates from the remaining debris. Various levels of taxonomic identification are required to classify aquatic invertebrates to general functional groups. Therefore, macroinvertebrates were counted and identified to the lowest taxan practical which was usually the generic level for aquatic insects. Several of the invertebrate groups (e.g., annelids, nematodes) were identified only to phyla and/or class levels. Taxonomic references used were Usinger (1956), Edmondson (1959), Mason (1973), Parrish (1975), Beck (1976), Edmunds et al. (1976), Wiggins (1977) and Merritt and Cummins (1978).

28. Macroinvertebrate communities in the lake were also collected using 1000 cm^2 Hester-Dendy multiple plate samplers (Hester and Dendy 1962). The plate samplers were suspended in the water column the day grab samples were collected. Four plate samplers were placed at each of eleven stations (see Figure 4 for location of each station). The samplers were suspended from floats with two samplers per float; one

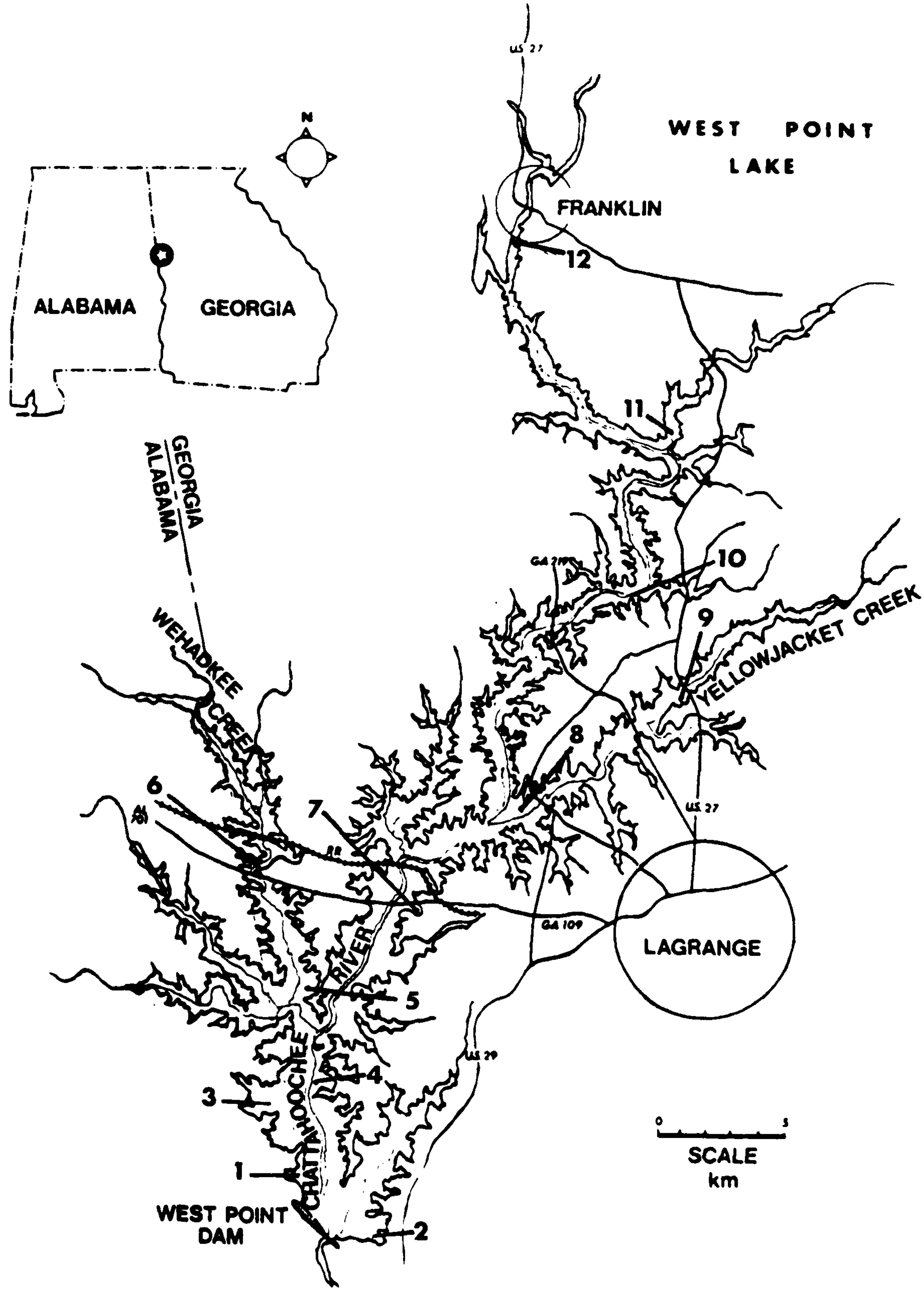


Figure 4. Benthic macroinvertebrate sample stations for dredge and plate samples.

sampler was approximately two feet below the surface of the water while the other was approximately two feet above the bottom. Floats were anchored by a brick attached to the string holding the samplers.

29. Plate samplers were left in the water for approximately four weeks. After this colonization period, samplers were retrieved and returned to the laboratory. Invertebrates were carefully removed from each sampler by scraping the plates, sieved through a U.S. Standard No. 30 sieve, and preserved in 70% alcohol containing rose bengal to stain the organisms. Samples were enumerated and identified to the lowest taxon practical with the same references used in processing the dredge samples. Species diversity ($\bar{d}$) and equitability (e) of all macroinvertebrate collections was calculated as in the zooplankton analysis.

Fishery Studies

Cove Rotenone Sampling

30. Studies of fish populations in 0.5- to 1-ha coves were made with rotenone. The general methods of sampling described by Chance (1958) and Hall (1974) were followed. The entrance to the cove was blocked with a 0.9-cm-mesh net. The volume of each cove was calculated on the basis of a plane-table map of the outline and mean depth readings. Emulsified rotenone (5%) was uniformly dispersed within the cove by first pumping through a weighted hose and then spraying the shallow areas. Potassium permanganate was used to control rotenone drift from the cove. Distressed fish were collected until no more surfaced. The fish were sorted, measured to total length by 2.5 cm-groups (inch groups) and weighed. The following morning fish were again picked up and measured. Two coves (Table 39) have been sampled each summer during the months of July-August ("Reference coves"). Two other coves were selected at random from the reservoir; the selection was accomplished by randomly choosing a shoreline area (from a grid superimposed on a map of the lake) and then selecting an appropriate sized cove that could realistically be "blocked-off" (Figure 5).

Marginal Rotenone Sampling

31. Fishes in the littoral areas of West Point Lake were collected by surrounding a 0.015-ha area with a net (30.5 x 2.7 m, with 0.5 cm mesh) equipped with a float and lead line, and applying the fish toxicant, rotenone, to the area surrounded. One end of the net was anchored on shore and a semi-circle was formed by feeding the net off the bow of the boat. The lead line was immediately examined by probing to be certain that it was on the bottom. Enough emulsified rotenone (5%) was applied to provide a 1-ppm concentration within the sample area. The material was poured through a weighted hose, or distributed at the surface in shallow water. The amount of rotenone used was small;

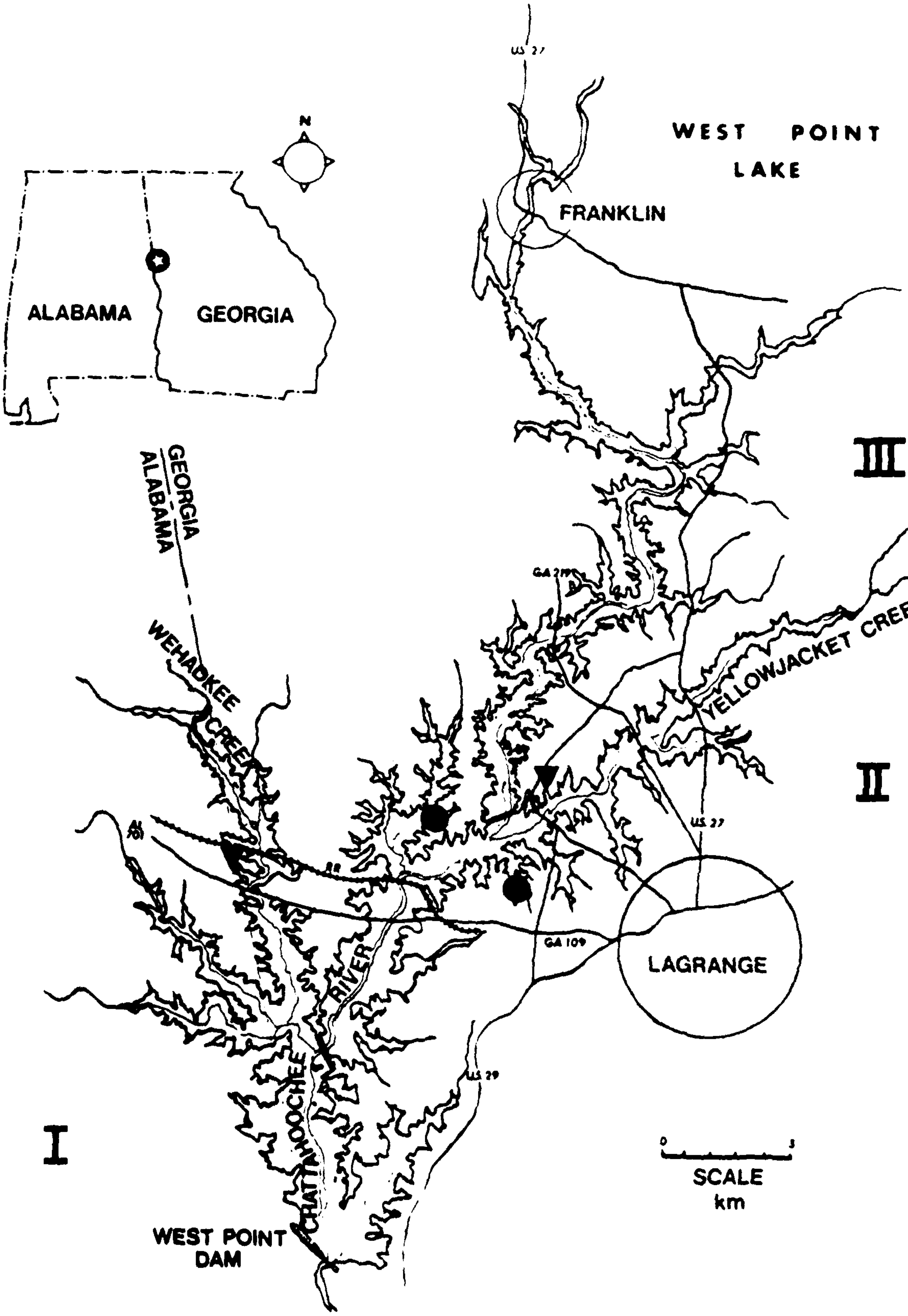


Figure 5. West Point Lake, Alabama-Georgia, showing cove rotenone sampling sites (▼, control; ●, random) and major sampling zones (I, II, III).

therefore no potassium permanganate was used. Fish were collected as they surfaced. Then the net was pulled directly onto the shore and fish in the net were removed. Small fish were preserved in 10% formalin and larger fish were held on ice in plastic bags. Fish were measured to the nearest millimeter (total length) and weighed to the nearest gram.

32. Sampling sites were chosen at random from the Yellowjacket Creek arm, Wehadkee Creek arm and the mainstream portion of the reservoir between these arms. A grid system with 0.65-km (0.25-square mile) section was used to select specific sites. Each section was assigned a number (from 1 to 500). Open-water sections were eliminated and one within each large area was chosen by using a table of random numbers. The shoreline segment was visually divided into six portions and the selection was determined by toss of a die. At least eight samples per trip were made each week. Sampling began in May and continued through September 1980.

Largemouth Bass Food Habits

33. Only stomachs from largemouth bass (ranging in size from 5-40 cm) collected by electrofishing and seining were examined for food items. A boat-mounted 110-volt A.C. generator with a pulsator unit that provided variable D.C. was used to electrofish nearshore areas. Fish were placed on ice to minimize regurgitation and later measured to the nearest millimeter total length and weighed to the nearest gram. Because of the importance of fish as prey, only the piscivorous habits (number and size of prey fish) were recorded.

Electrofishing Sampling

34. Large impoundments contain a wide range of habitats from which fish populations can be sampled. Collection sites that contain representative segments of the population must be selected to precisely and accurately estimate some characteristics of the population. Bayne et al. (1980) determined that there was no benefit (increased precision) from repeated sampling of "reference sites." Therefore strictly random sampling was employed during 1979-1980 (Phase IV).

35. The reservoir was divided into three major zones of about equal area (3,500 ha) for sampling. Zone I was the southernmost portion of the reservoir nearest the dam; zone II consisted of the middle portion of the reservoir which included a major arm receiving effluent from a city with 26,000 inhabitants; zone III was essentially confined to the former flood plain of the river (Fig. 5).

36. Selection of the random sampling sites was achieved by superimposing a grid (0.65 km^2) on a reservoir map. Grids adjacent to the shoreline were numbered and given equal probability of selection

for sampling. One grid area from each major zone was selected each sampling day.

37. The year, October, 1979-September, 1980, was blocked into three seasons: October-December, February-April, and June-August. Twice monthly (6 times each season) electrofishing trips were conducted. Each trip consisted of four 45-minute sampling periods, three during the day and one at night. The three daytime shocking locations were picked at random as described above. A single night location was selected randomly from the day areas by simply selecting one where each had an equal probability of being chosen. The exact location of the nighttime sample was marked by placing a flashing light on shore at the beginning of the randomly chosen daytime location. A coin toss decided whether the daytime samples was taken to the right or left of the marker. Nighttime shocking began at the marker approximately 3-4 hours after nightfall and continued for 45 minutes in the opposite direction along the section of shoreline adjacent to the day shocking area.

38. The equipment used for electrofishing consisted of a Polarcraft 16-foot aluminum boat with a livewell and safety guardrail surrounding the bow. The boat was powered by a 35-horsepower Johnson outboard motor with remote throttle and steering. Twin boom-mounted positive electrodes extended from the bow and two negative electrodes were attached directly to the bow on either side. A Homelite 110 to 220-volt alternating current generator supplied electrical current; the alternating current was transformed to one-half pulsed direct current with a Coffelt variable voltage pulsator (model VVP-2C). Six 150-watt floodlights provided lighting to the water around the electrodes during night sampling.

39. Before each sample, the environmental factors of water temperature, wind velocity and direction, light intensity, Secchi disc visibility, and conductivity were measured and quantity of shoreline structure was evaluated. For the day-night comparison, bass were counted and measured then immediately returned to the water; all other species were collected. The bass were grouped as being less than 20 cm, between 20 and 30 cm, between 30 and 38 cm, or greater than 38 cm in total length.

Roving Creel Survey

40. Thirty-seven boat access points (Fig. 5) were in use during the period of study. Because of the large number of access points in the reservoir, we felt that the number of interviews which could be obtained at any one access point during a sampling period usually would be too few for our purposes. Therefore the roving creel survey, where fishermen are actively contacted, was a necessity.

41. The application of nonuniform probability sampling to the roving creel survey has been outlined by Malvestuto et al. (1978). The following is a summary of the basic features of this approach:

(a) The entire period for which the fishery is to be surveyed is divided into time blocks. The amount of fishing expected to take place within these blocks should be similar.

(b) Each time block is divided into sampling units (the time periods during which sampling will take place on the lake) such that all of the fishing time within a block is contained within the sampling units and the units do not overlap.

(c) Sampling probabilities proportional to the amount of fishing expected are assigned to the sampling units. The sum of the probabilities assigned to the sampling units within any given block equals 1.0.

42. Our survey was divided into time blocks of 1 month and the blocks divided into sampling units of 4 hours. Any given day contained three sampling units spanning a 12-hour (hr) fishing period. These units were designated the A.M., Noon, and P.M. sampling periods, ranging from 0600 to 1000 hr, 1000 to 1400 hr, and 1400 to 1800 hr, respectively (all times were moved ahead 1 hr during daylight savings time).

43. Fishing patterns for West Point Lake have shown a marked difference between fishing pressure on weekdays and weekends; these two time categories thus were classified as separate strata. Three units were worked monthly within each stratum except for the winter period (November-January). During the winter period when fishing pressure decreased, a total of six sampling units (three in each stratum) were assigned.

44. A particular sampling unit was chosen by first randomly choosing a day, where all days within a month were given equal probability of being chosen, and then, within the chosen day, randomly choosing one based on the amount of fishing expected to occur during that period. Expected fishing was estimated from fishermen counts made on the lake during the A.M., Noon, and P.M. sampling periods. The sampling probabilities for these three periods summed to 1.0. Sampling periods were chosen independently for each stratum each month.

45. The large size of the reservoir required its division into six sections, one section being sampled during a sampling period. Since there are no vantage points, counts were made by making a circuit, by boat, of the section being sampled. The section sampled was chosen with probability proportional to the amount of fishing expected in that section (Shelton et al. 1981).

46. Sampling on the lake in 1980 was conducted by choosing at random (by coin toss) the direction (right or left) in which the creel

clerk circled the lake section. Groups of fishermen interviewed were chosen so that one complete circuit was made during the time allotted to interviews. During each interview, the number and lengths of all fish caught were recorded by species. Lengths were later converted to weights using weight-length tables for Alabama fishes (Swingle 1972). The length of a fishing trip at the time of the interview (incompleted trip length) was an estimate based on the fisherman's memory as to what time he began fishing. Using this sampling scheme where months are stratified into weekdays and weekends the data may be expanded as discussed by Malvestuto et al. (1978).

47. The creel survey design, in terms of its ability to detect changes in catch per effort (CPE) of largemouth bass, is quite adequate for our purposes. The evaluation provided a basis by which our design was modified so that the precision of the survey was maintained while sampling effort was substantially reduced.

48. The primary justification for reduced sampling is that sample size appears to have no effect on the precision of the survey, at least within the range of 5 to 10 sample days per month. Summer sampling was reduced from 10 to 6 days per month during Phases II and III without significantly impairing the precision of the estimates (Malvestuto et al. 1978). During 1979-1980 (Phase IV) this sampling regime was continued.

49. The precision of the survey during the winter is, in general, 2 to 3 times lower than in the summer. This is seemingly due to the irregular fishing effort and catch during the winter as dictated by the vagaries of the weather. To substantially increase winter sampling in order to increase the precision of winter estimates would not be efficient because only about 10% of the annual total harvest is expected to occur during this part of the year. It is obvious, however, that we must sample during the winter to obtain an estimate of winter harvest despite the fact that the precision of this estimate will be low.

50. Malvestuto et al. (1978) suggest a modified survey design based on a minimum of 45 sample days per year rather than the 90 days used previously (Davies et al. 1979). Initially however, it was reduced to 60 days per year. Because we are primarily interested in obtaining estimates of harvest, it was logical to allocate our seasonal sampling effort proportional to harvest; that is, 10%, or 6 days, would be sampled during the winter (November-January) and the remaining 54 sample days would be allocated to the summer season (February-October). The winter fishing pattern begins in November and continues through March, but due to the advent of the early crappie fishery, February and March are included within the more intensely sampled summer period.

51. The low precision of the survey during the winter suggests that it is not profitable to obtain monthly estimates during this part of the year. As a result the 6 sample days (3 weekdays and 3 weekend days) were randomly chosen from all days within the 3 month period. It

is probably desirable to maintain monthly estimates during the summer so that changes in the species composition of the harvest during this 9-month period can be accurately documented. In such a case, 6 sample days (3 weekdays and 3 weekend days) would be randomly chosen each month.

52. This modified creel survey program will provide unbiased annual estimates of harvest while maintaining the relatively high precision {Coefficient of Variation (C.V.) at approximately 30%} of the survey during the summer fishing season. At the same time, annual creel survey effort was reduced by 33%.

Sampling Schedule

53. The following schedule illustrates the timing of routine sampling outlined in the scope of work[1]:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Electro-fishing	X[2]	X	X	X	X	X	X	X	X	X	X	X
Cove rotenone							X[3]	X				
Marginal rotenone					X[4]	X	X	X				
Gill netting								X	X	X	X	X
Trapping								X	X	X	X	X

[1] Specialized sampling discussed in appropriate section.
[2] Thirty-six days/year.
[3] Four cove rotenone samples/year.
[4] Eight samples per weekly trip.

RESULTS AND DISCUSSION

Limnological Results

Plankton

Phytoplankton

54. Phytoplankton Abundance. Data on phytoplankton density at the mainstream stations are presented in Figures 6-9. The data in these four figures show an increase in density for the phytoplankton community between the upper reaches of the lake at station A to the lower reaches at station D. This was true for each of the four sample dates. Phytoplankton density in the two major arms of the reservoir, Yellowjacket and Wehadkee Creeks, appear in Table 3. Chlorophyll *a*, *b* and *c* concentrations expressed on a volume basis are also included in Figures 6-9 and Table 3. Annual mean phytoplankton densities for each station appear in Table 4. Mean phytoplankton densities for each station and date appear in Appendix A, Table 4.

55. At mainstream stations phytoplankton density for the year varied from a high of 2,083 organisms/ml at station D to a low of 494 organisms/ml at station A (Table 4). Density measured at station G in Yellowjacket Creek averaged 1,856 organisms/ml for the year while density averaged 1,400 organisms/ml at station F in Wehadkee Creek (Table 4).

56. Yearly phytoplankton density for the lake ranged from a high in August of 2,514 organisms/ml to a low during February of 559 organisms/ml (Table 5).

57. Group Dominance. Yellow-green algae (Chrysophyta) numerically dominated phytoplankton samples at all mainstream stations on any given date (Figures 6-9). For the lake as a whole, yellow-green algae dominated samples on three of the four dates (Tables 5 and 6). Green algae (Chlorophyta) ranked second in abundance except for the May sample when blue-green algae (Cyanophyta) were more abundant. The October samples from stations C, D, E and G had large numbers of green algae compared with other stations in the reservoir (Appendix A, Table 4).

58. Examination of the yearly means for each station shows that yellow-green algae (mostly diatoms) dominated numerically except at station C (Table 4). In fact, station B and C were the only locations where diatoms were not found in much greater abundance than green and blue-green algae.

59. Data reported in Appendix A, Table 4 reveals much about the variability of phytoplankton communities in a lake. Each date had one or more stations where significant pulses, or increases, in numbers of

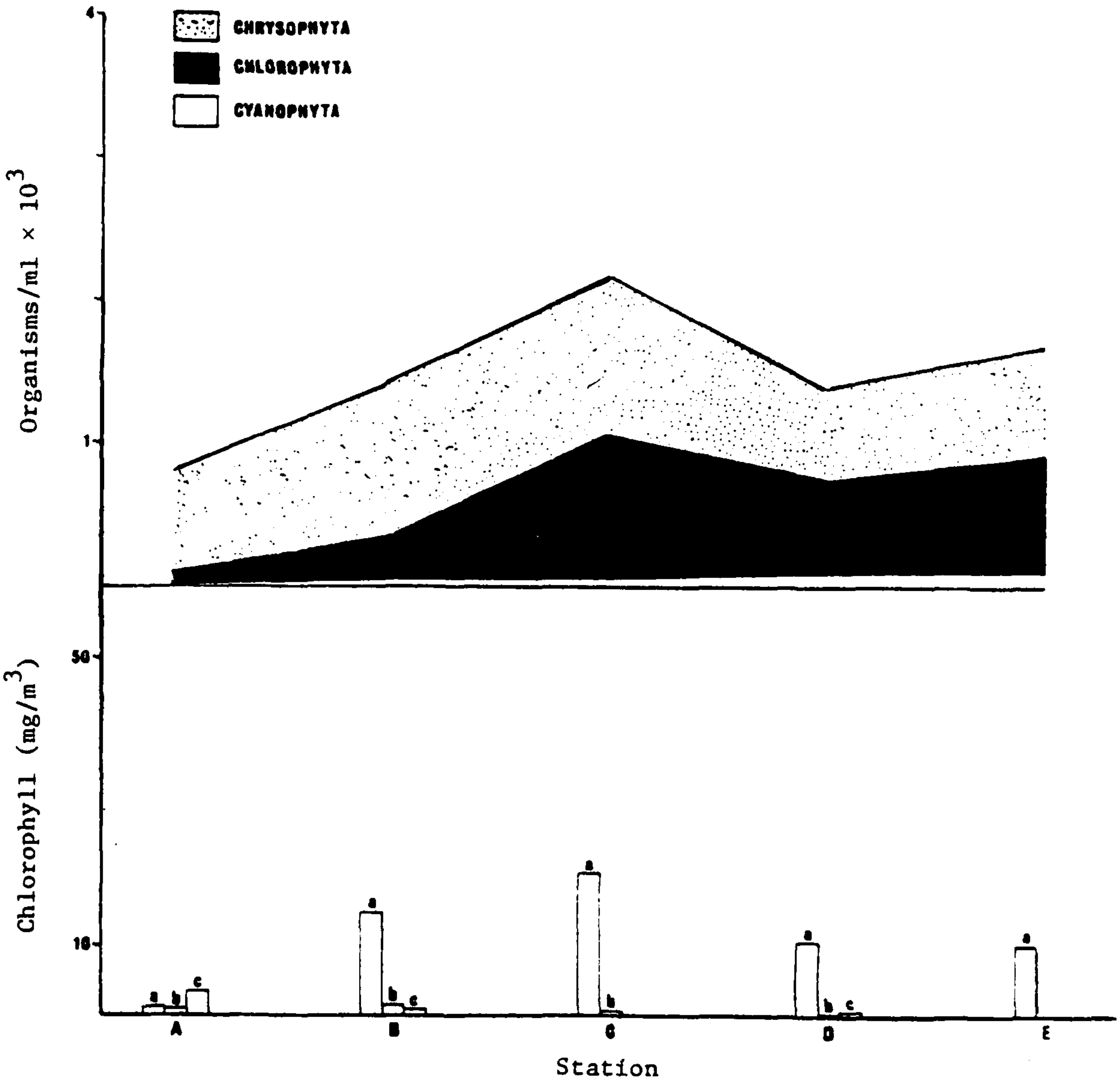


Figure 6. Phytoplankton standing crops (organisms/ml) and chlorophyll a, b and c concentrations (mg/m^3) at mainstream sampling stations on West Point Lake 17 October 1979. Values represent means of all samples taken at all depths.

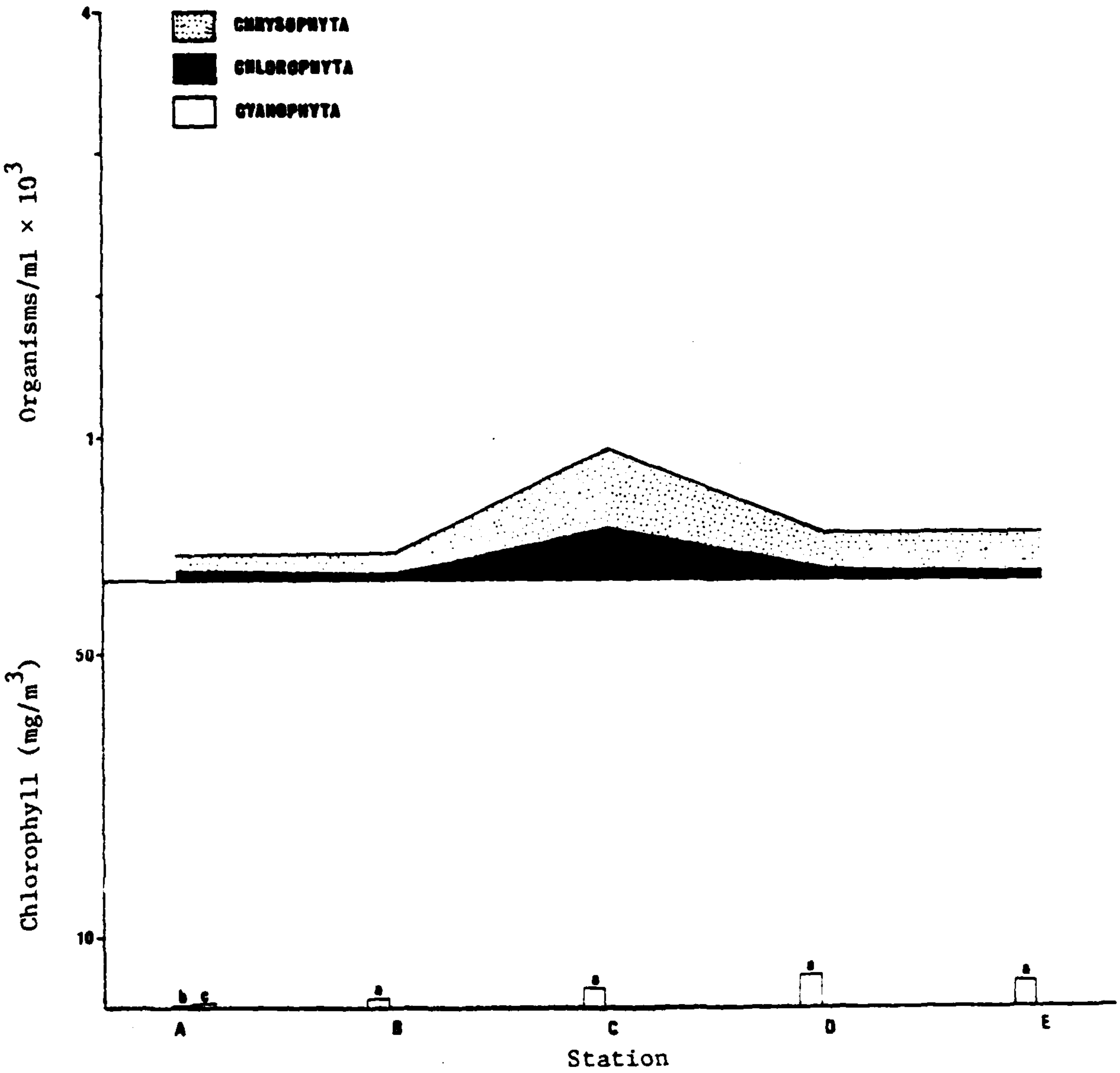


Figure 7. Phytoplankton standing crops (organisms/ml) and chlorophyll a, b and c concentrations (mg/m^3) at mainstream sampling stations on West Point Lake 12 February 1980. Values represent means of all samples taken at all depths.

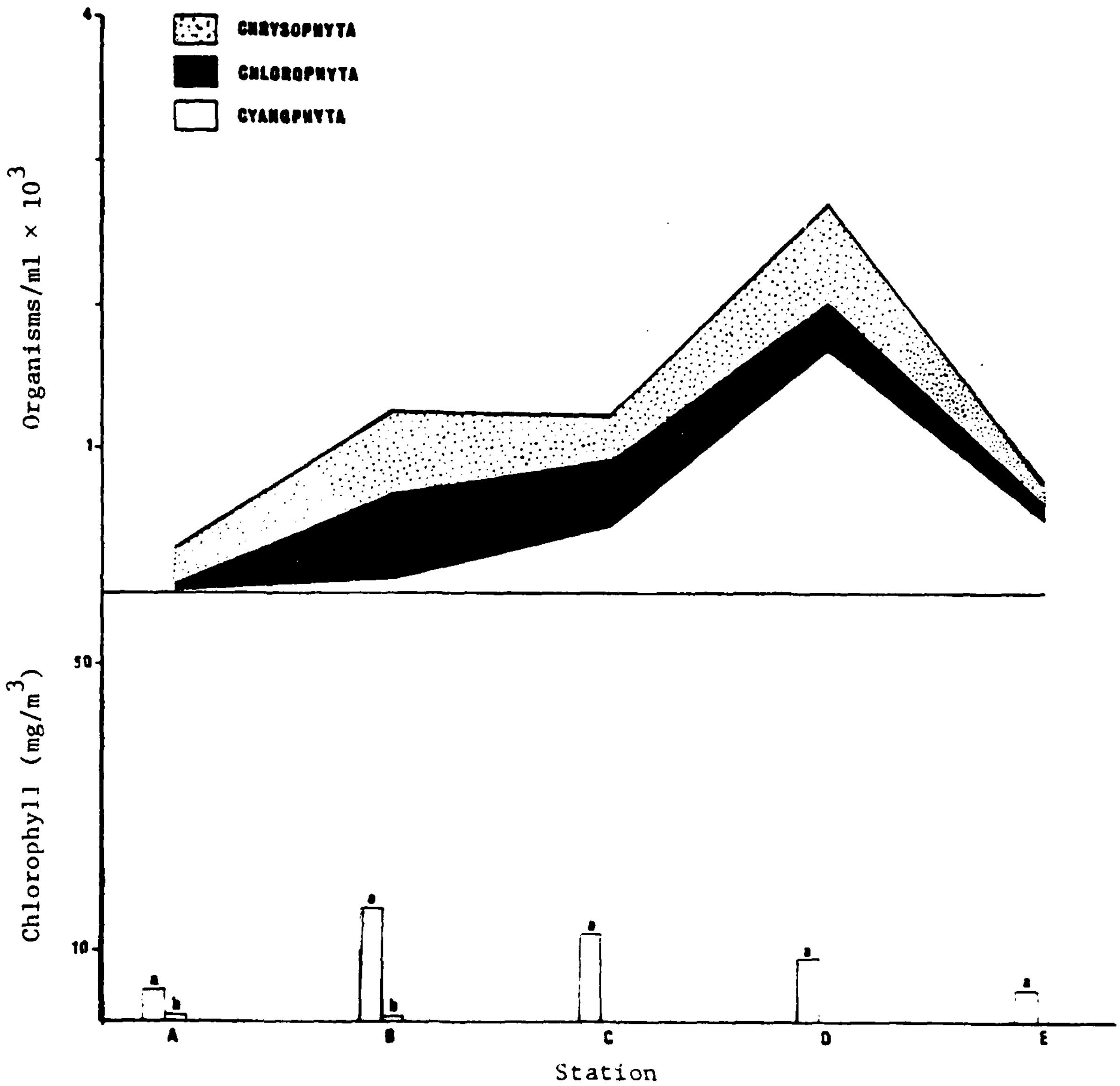


Figure 8. Phytoplankton standing crops (organisms/ml) and chlorophyll a, b and c concentrations (mg/m^3) at mainstream sampling stations on West Point Lake 9 May 1980. Values represent means of all samples taken at all depths.

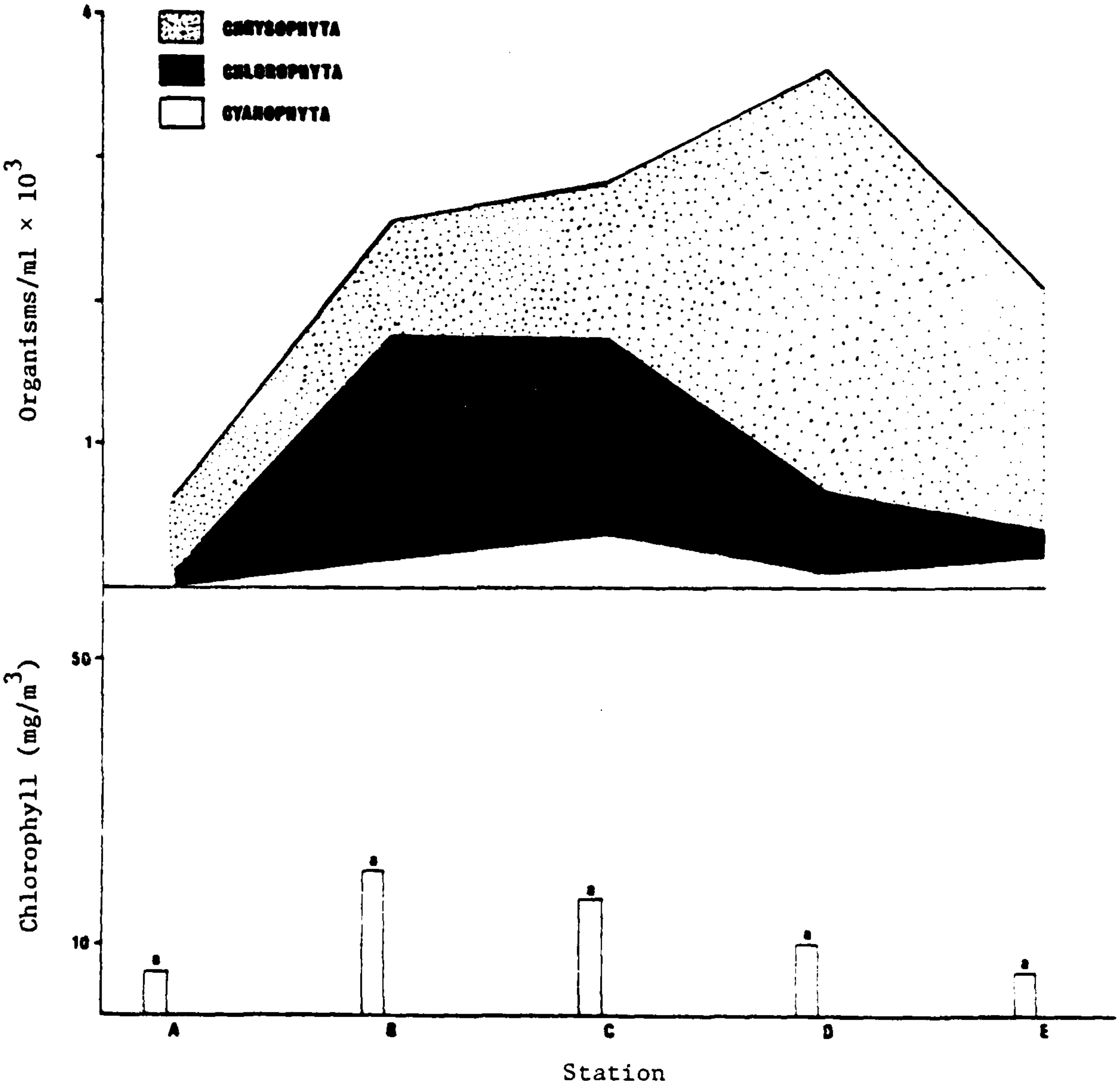


Figure 9. Phytoplankton standing crops (organisms/ml) and chlorophyll a, b and c concentrations (mg/m^3) at mainstream sampling stations on West Point Lake 5 August 1980. Values represent means of all samples taken at all depths.

Table 3

Mean number of phytoplankters (organisms/ml) and mean chlorophyll concentrations (mg/m^3) in Yellowjacket and Wehadkee Creeks on all sampling dates, 1979-80. Values represent means of all samples taken at all depths.

	1979	1980		
	Oct	Feb	May	Aug
	YELLOWJACKET CREEK (Station G)			
	organisms/ml			
ALGAL DIVISION				
Chrysophyta	1,078	1,190	338	1,346
Chlorophyta	1,361	150	268	774
Cyanophyta	39	4	470	128
Others	104	79	19	75
Total	2,582	1,423	1,095	2,323
	mg/m^3			
CHLOROPHYLL (mg/m^3)				
Chlorophyll a	24.94	16.23	10.19	14.26
Chlorophyll b	0.71	2.86	0.00	0.00
Chlorophyll c	0.00	2.86	0.00	0.00
	WEHADKEE CREEK (Station F)			
	organisms/ml			
ALGAL DIVISION				
Chrysophyta	1,442	147	835	992
Chlorophyta	285	27	310	568
Cyanophyta	25	18	54	266
Others	196	7	302	128
Total	1,948	199	1,501	1,954
	mg/m^3			
CHLOROPHYLL (mg/m^3)				
Chlorophyll a	10.48	4.44	5.71	12.57
Chlorophyll b	0.27	0.00	0.00	0.00
Chlorophyll c	0.14	0.00	0.00	0.00

Table 4

Mean phytoplankton numbers (organisms/ml) for each station on all sampling dates during 1979-80.

Algal Division	Stations						
	A	B	C	D	E	F	G
	organisms/ml						
Chrysophyta	385	648	771	1,136	714	854	988
Chlorophyta	81	624	796	402	287	297	638
Cyanophyta	11	86	223	471	210	90	160
Others	17	25	74	74	63	159	70
Total	494	1,383	1,864	2,083	1,274	1,400	1,856

Table 5

Mean phytoplankton numbers (organisms/ml) for West Point Lake on each sampling date during 1979-80.

Algal Division	1979	1980		
	Oct	Feb	May	Aug
	organisms/ml			
Chrysophyta	986	404	504	1,434
Chlorophyta	654	111	339	817
Cyanophyta	52	6	555	185
Others	98	38	77	78
Total	1,790	559	1,475	2,514

Table 6

Dominance ranking of phytoplankters identified from samples taken at each sampling station during 1979-80 sampling year.

Organism	Date	17 October 1979							12 February 1980							9 May 1980							5 August 1980						
	Station	A	B	C	D	E	F	G	A	B	C	D	E	F	G	A	B	C	D	F	F	G	A	B	C	D	E	F	G
CHRYSOPHYTA																													
Centric diatoms		1	3	1	2	3	1	2	1	1	1	2	1	1	2	1	1	5	5	3	2		1		1	1	1	1	1
Melosira granulata		2	2											3		4	4	5	2	4	5	2							
M. varians				2		5	4		3		3	1	5				4				4		2						
Cyclotella sp.							2			3		6	3		1	3	3	2	3	2	1		3	2	4				6
Chrysococcus sp.					7												3												
Dinobryon sp.																													
Pseudotetraedron neglectum																													
Ophiocytium sp.																													
Asterionella											4		2						7									5	
CHLOROPHYTA																													
Ankistrodesmus sp.									4			3		4															
A. convolutus		5	1	3	4	1	3	1		2	5				4	3	5	3	6	5	4	4							
A. falcatus																	5			6						3			
A. nannoselene																													
Scenedesmus sp.									2		2		4																
S. quadricauda			7	4	1	2	6												9					1	4				
S. acuminatus																		6											
S. armatus																		6											
S. abundans																													
S. denticulatus		3						3									5	6					5			5			5
S. bijuga					6																								
Pandorina charkowiensis																	5		9			5							4
P. morum																			8										
Dictyosphaerium sp.																													
Eudorina elegans																													
Actinastrum sp.																												5	
Closterium sp.																													
Cosmarium sp.																									3	2	3		3
Golenkinia sp.																		6	8		5	3	5	4		3			6
Actinodesmus sp.																													
Sphaerocystis sp.																	3	5	8										
Kirchneriella sp.																													
Chlamydomonas sp.		4	4	6	3	7		6							3	3	2	4		6	5				5	5			
Crucigenia sp.																													
Pediastrum sp.			5																				4					5	
Schroederia sp.																							5						
Staurastrum sp.																	5									4	4	2	6
Unid. green flagellate																													
Coelastrum sp.																5	5									5			
Tetrastrum sp.													5																
Micractinium sp.																5		5	0										
Oocystis sp.																													4
Euastrum sp.																											5		

Table 6. Continued.

Organism	17 October 1979							12 February 1980							9 May 1980							5 August 1980						
Station	A	B	C	D	E	F	G	A	B	C	D	E	F	G	A	B	C	D	E	F	G	A	B	C	D	E	F	G
CYANOPHYTA																												
Anabaena sp.																											5	
Gomphosphaeria sp		6		5									2										5	5			5	6
Merismopedia sp.																							3					
Oscillatoria angustissima	6		5		6						4						1	1	1		1		4	4				
Chroococcus sp.																							4					
Microcystis sp.																	3	4	6									
Cylindrospermum sp.																										3	3	6
Lyngbya sp																								2		2		2
EUGLENOPHYTA																												
Trachelomonas sp.																4	7			6		5					4	
Phacus sp							5																					
Euglena sp.																											5	6
Unid. pigmented flagellate															2					3								
PYRRHOPHYTA																												
Gymnodinium sp.																					5							
Peridinium sp.					4	5	4				5	6		5										5				6
Glenodinium																			6									
Unid. dinoflagellate																												

green and/or blue-green algae were collected in addition to the usual high number of yellow-green algae.

60. Species Dominance. Dominant phytoplankters were ranked by algal division and are presented in Table 6. Pennate diatoms were not routinely identified to genus because of time limitations. The most commonly encountered pennate diatom that could be identified without special preparation was *Asterionella* spp. Pennate diatoms occupied prominent positions in the dominance ranking at most stations on all sampling dates.

61. Other phytoplankters commonly encountered were the centric diatoms *Melosira granulata* and *M. varians*, the green coccoids *Ankistrodesmus convolutus* and *Scenedesmus quadricauda* and the green flagellate *Chlamydomonas* spp. *Oscillatoria angustissima* was the dominant blue-green alga overall and the dominant phytoplankter at stations C, D, E and G on 9 May 1980.

Chlorophyll

62. Chlorophyll values measured on a volume basis (mg/m^3) generally exhibited the same pattern as phytoplankton density at mainstream stations (Figures 6-9). Mean chlorophyll *a* concentrations at each station and date appear in Table 7. During the 1979-80 year mean

Table 7

Chlorophyll a concentrations at sample stations in West Point Lake. Values are means of all depths measured at that station.

Year	Month	Station A	B	C	D	E	F	G
		Chlorophyll *a* (mg/m^3)						
1979	Oct	1.3	14.8	20.1	10.5	10.2	10.5	25.0
	Dec	1.4	1.6	5.1	16.6	11.2	22.5	16.9
1980	Feb	0.0	1.2	2.7	4.3	3.5	4.4	16.2
	Mar	2.3	1.2	1.2	2.6	1.2	2.0	2.3
	May	4.5	16.0	12.5	9.1	4.4	5.7	10.2
	Jun	2.9	19.3	12.1	14.5	5.6	5.8	11.2
	Aug	6.0	20.3	16.4	9.8	6.0	12.6	14.3
	Sept	4.0	22.6	19.5	19.6	10.9	12.1	19.3

chlorophyll a concentrations ranged from a low of 0.0 mg/m^3 at station A in February to a high of 25.0 mg/m^3 at station G in October. The yearly mean chlorophyll a concentrations for the lake the past four years were: 13.1, 9.5, 9.8 and 10.3 mg/m^3 for 1976-77, 1977-78, 1978-79 and 1979-80, respectively.

63. Values converted to an areal basis (mg/m^2) and referred to as chlorophyll standing crops appear in Tables 8, 9 and 10. Chlorophyll a standing crop was measured from a high of 160.7 mg/m^2 at station D in September to a low of 0.0 mg/m^2 at station A in February (Table 8). The highest chlorophyll b and c standing crop was 8.0 mg/m^2 and 14.6 mg/m^2, respectively, measured at station G in February (Table 8). Chlorophyll c values for this year were much lower than the previous year (Shelton et al. 1981). Annual mean chlorophyll a standing crops ranged from a high of 77.1 mg/m^2 at station D to lows of 5.6 mg/m^2 and 6.6 mg/m^2 at stations A and E, respectively (Table 9). Station A is located in the headwaters of the lake, station E in the tailwaters and station D is the lower-most station within the reservoir. On all dates, except for December, chlorophyll a standing crop was higher in Yellowjacket Creek than in Wehadkee Creek (Table 8).

Primary Productivity

64. Mean net primary productivity values by station and date are presented in Table 11. The mean net primary productivity, chlorophyll a standing crop and turbidity are plotted together in Figure 10. Estimates of seasonal and annual mean net primary productivity for the reservoir appear in Table 12. Productivity varied greatly between stations and dates ranging from a low of 5.1 mg C/m^2/day at station A during December to a high of 2,408.8 mg C/m^2/day at station B during September (Table 11). Seasonal productivity was lowest in winter and highest in the fall ranging from 79.3 mg C/m^2/day to 1,160.6 mg C/m^2/day, respectively (Table 12).

65. At mainstream stations highest yearly mean production was 89[illegible].1 mg C/m^2/day at station B followed in descending order by station D at 631.3 mg C/m^2/day, station C at 445.1 mg C/m^2/day, and station A at 32.8 mg C/m^2/day. Productivity in Wehadkee and Yellowjacket Creeks was 574.5 mg C/m^2/day and 478.4 mg C/m^2/day, respectively. Productivity in the two creeks was similar to that measured at mainstream station C (Table 11).

Organic Matter and Carbon

66. Organic Content of Suspended Matter. The dry weight of particulate suspended matter filtered from water samples collected at each station and depth is presented in Table 13. The organic fraction

Table 8

Chlorophyll a, b and c standing crops (mg/m^2) at all stations and on all dates during the 1979-80 sampling year. Values represent means of all samples taken at all depths.

	Station	A			B			C			D			E			F			G		
		Chlorophyll (mg/m^2)																				
Year	Month	a	b	c	a	b	c	a	b	c	a	b	c	a	b	c	a	b	c	a	b	c
1979	Oct	2.5	2.5	6.5	58.6	6.2	3.0	80.8	3.6	0.0	83.5	1.0	3.2	10.2	0.0	0.0	44.9	0.8	0.4	105.6	2.8	0.0
	Dec	2.8	0.3	1.1	6.5	0.0	0.0	20.8	4.0	0.9	70.0	1.2	0.0	11.2	0.1	0.0	88.3	1.5	0.0	65.0	4.4	0.0
1980	Feb	0.0	0.8	1.1	4.6	0.0	0.0	11.6	0.0	0.0	35.6	0.2	0.0	3.5	0.0	0.0	17.8	2.9	0.0	65.1	8.0	14.6
	Mar	4.6	0.0	0.0	3.5	0.0	0.0	3.5	0.0	0.0	22.1	0.0	0.0	1.2	0.0	0.0	7.0	0.0	0.0	9.3	0.0	0.0
	May	8.9	1.8	0.0	64.8	2.6	0.0	51.1	0.0	0.0	75.1	0.0	0.0	4.4	0.5	0.0	23.8	0.1	0.0	43.0	0.0	0.0
	Jun	5.8	0.0	0.0	74.8	5.4	0.0	56.5	1.1	0.0	129.3	7.8	0.0	5.6	0.1	0.0	27.5	0.0	0.0	47.0	3.2	0.0
	Aug	11.8	0.0	0.0	81.7	0.0	0.0	68.8	0.0	0.0	40.1	0.0	0.0	6.0	0.0	0.0	52.4	0.0	0.0	59.0	0.0	0.0
	Sep	7.9	0.1	0.0	88.2	0.0	0.0	78.0	0.0	0.0	160.7	0.0	0.0	10.9	0.0	0.0	47.9	0.0	0.0	79.3	0.0	0.0

Table 9

<u>Mean chlorophyll standing crops (mg/m^2) at each station for all sampling dates. Values represent means of all depths measured at that station.</u>

Chlorophyll	Station A	B	C	D	E	F	G
				mg/m^2			
a	5.6	47.8	46.4	77.1	6.6	38.7	59.2
b	2.2	1.8	1.1	1.3	0.1	0.6	2.3
c	1.1	0.5	0.1	0.4	0.0	0.1	1.8

Table 10

<u>Mean chlorophyll standing crops (mg/m^2) on each sampling date for all stations. Values represent means of all depths measured at that station.</u>

	1979		1980					
Chlorophyll	Oct	Dec	Feb	Mar	May	Jun	Aug	Sep
					mg/m^2			
a	55.2	37.8	19.8	7.3	38.7	49.5	45.7	67.6
b	2.4	1.6	1.7	0.0	0.7	2.5	0.0	0.0
c	1.9	0.3	2.2	0.0	0.0	0.0	0.0	0.0

Table 11

Mean primary productivity values by station and date for West Point Lake during 1979-80.

Station	Date: Dec	Mar	Jun	Sept	$\bar{X}$
			mg C/m^2/day		
A	5.1	6.5	85.2	34.2	32.8
B	18.1	6.9	1150.7	2408.8	896.1
G	233.0	103.7	609.8	966.9	478.1
C	94.5	27.2	764.1	894.6	445.1
F	79.5	898.5	940.5	379.5	574.5
D	160.3	136.4	1155.5	1073.1	631.3

Table 12

Estimated quarterly mean primary productivity (mg C/m^2/day) of West Point Lake on sampling dates during 1979-80.

Quarter Sampling month	Winter Dec 1979	Spring Mar 1980	Summer Jun 1980	Fall Sep 1980
		mg C/m^2/day		
Quarterly mean	79.3	116.5	881.1	1,160.6
Annual mean		559.4		

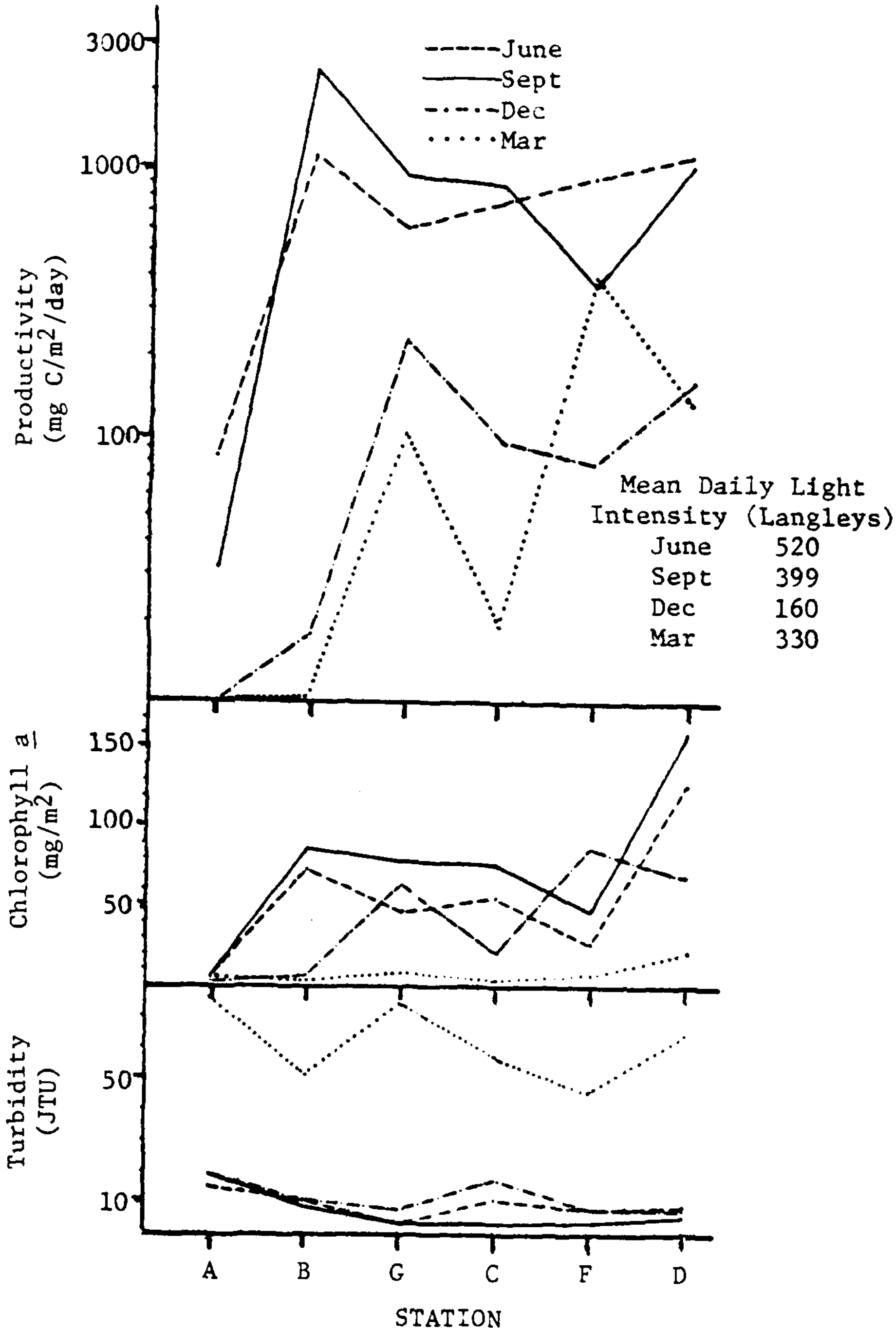


Figure 10. Net primary productivity (mg C/m^2/day), chlorophyll a standing crop (mg/m^2), turbidity (JTU) and mean daily light intensity (Langleys) for quarterly samples during 1979-80 on West Point Lake. The light intensity values are the average daily light intensity for that quarter in which sampling occurred.

Table 13

<u>Total suspended matter (mg/l) of water samples taken at each station and depth on all dates in West Point Lake during 1979-80.</u>

Station	Depth (m)		17 Oct 79	5 Dec 79	12 Feb 80	9 May 80	5 Jun 80	5 Aug 80	4 Sept 80
						mg/l			
A	0		28.9	25.3	32.7	12.1	9.5	24.4	24.8
	2		57.0	30.1	27.2	15.1	42.9	13.9	30.4
		$\bar{X}$	43.0	27.7	30.0	13.6	26.2	19.2	27.6
B	0		6.8	10.3	26.5	8.6	5.4	4.3	6.8
	2		8.0	9.3	26.7	4.2	7.9	3.4	8.9
	4		11.8	9.4	25.4	9.4	13.2	3.7	10.2
	8		14.6	9.9	--*	8.8	30.5	10.9	11.7
	12		20.3	32.4	--	10.3	22.6	11.3	18.6
		$\bar{X}$	12.3	14.3	26.2	8.3	15.9	6.7	11.2
C	0		3.9	11.4	9.7	4.0	4.2	3.1	5.2
	2		--	9.9	11.2	3.7	5.0	2.5	4.7
	4		3.5	8.5	10.3	3.5	3.5	1.8	4.2
	8		3.3	11.1	11.1	4.6	10.3	2.9	4.4
	16		4.2	--	12.9	10.2	10.8	12.0	14.8
		$\bar{X}$	3.7	10.2	11.0	5.2	6.8	4.5	6.7
D	0		1.8	4.8	6.5	3.5	2.7	1.3	4.4
	2		2.0	3.5	8.3	4.4	3.1	1.0	5.1
	4		2.1	4.7	6.8	3.3	4.3	0.9	4.1
	8		1.4	4.0	5.2	3.5	4.7	1.2	2.9
	16		3.5	5.4	3.6	5.0	9.5	3.5	10.0
	24		9.2	5.5	29.1	7.4	7.6	5.3	12.1
		$\bar{X}$	3.3	4.7	9.9	4.5	5.3	2.2	6.5
E	0		5.1	8.7	5.7	4.5	6.9	2.0	5.0
F	0		4.7	8.8	15.2	3.4	2.1	1.3	6.0
	2		3.9	7.4	14.5	3.4	4.8	2.0	4.7
	4		5.7	8.6	14.8	3.8	4.2	1.9	4.9
		$\bar{X}$	4.8	8.3	14.8	3.5	3.7	1.7	5.2
G	0		3.1	7.4	6.6	3.4	2.9	2.1	4.5
	2		3.9	5.2	6.2	2.4	3.1	2.0	4.0
	4		4.6	6.8	7.6	1.8	4.7	2.0	3.5
		$\bar{X}$	3.9	6.5	6.8	2.5	3.6	2.0	4.0

*Dash (--) indicates no data for that date and depth.

of these suspended matter samples appears in Table 14. The distributional pattern of suspended organic matter at mainstream stations for selected dates is presented in Figure 11.

67. Some of the suspended organic matter (SOM) measurements in Table 14 are higher than the total suspended matter values reported in Table 13 for the same location. There was no satisfactory explanation for this discrepancy. In general, this method of estimating the SOM provides a useful measure of organic content of the sample even though it is an approximation.

68. Total suspended matter means were higher in the upper reaches of the reservoirs at stations A and B. Moving down the reservoir toward the dam the amount of suspended matter in the water decreased (Table 13).

69. Total Carbon (TC). Total carbon content of water samples collected from each station and depth during 1979-80 appears in Table 15. Mean values at a particular station ranged from a low of 6.3 mg/l at station F in Wehadkee Creek to a high of 13.4 mg/l at station G in Yellowjacket Creek (Table 15).

70. Total Organic Carbon (TOC). Total organic carbon values measured from water samples collected at each station are presented in Table 16. TOC means ranged from a low of 1.9 mg/l at station E in February to a high of 10.3 mg/l at station G in September. Mean TOC values for the year were 5.1 mg/l. The relationship of TOC to suspended organic matter for selected dates is presented in Figure 11.

Zooplankton

71. Zooplankton Abundance. The mean numbers of zooplankters collected on each date at mainstream stations appear in Figure 12 and 13. The same type of data for Yellowjacket and Wehadkee Creeks appears in Table 17. Annual means for each station are presented in Table 18 while mean density for the lake on each date appears in Table 19. Appendix A, Table 5 includes mean density by station and date for 1979-80.

72. Zooplankton density for the year at mainstream stations averaged from 6 organisms/l at station A to 273 organisms/l at station C (Table 18). Density was highest at station G in Yellowjacket Creek with a mean of 281 organisms/l. Zooplankton abundance exhibited pronounced seasonal variations. Mean density ranged from highs of 387 and 321 organisms/l in May and October, respectively, to lows of 21 and 38 organisms/l in August and February, respectively (Table 19). The low abundance obtained in August samples was unexpected since zooplankton populations are usually quite dense during this period.

Table 14

Suspended matter organic content (mg/l) of water samples taken at each station and depth on all dates in West Point Lake during 1979-80.

Station	Depth (m)	17 Oct 79	5 Dec 79	12 Feb 80	9 May 80	5 Jun 80	5 Aug 80	4 Sept 80
					mg/l			
A	0	6.26	6.08	6.76	2.28	3.68	12.64	3.96
	2	9.64	6.48	5.74	2.42	7.60	2.56	4.80
	$\bar{X}$	7.95	6.28	6.25	2.35	5.64	7.60	4.38
B	0	3.38	2.16	5.44	2.46	3.70	2.82	4.40
	2	--*	2.56	5.20	2.16	3.40	2.30	3.84
	4	4.04	2.50	5.58	3.30	4.04	2.06	3.36
	8	4.06	2.86	--	2.74	5.00	3.28	3.24
	12	5.56	5.70	--	1.82	5.82	2.88	4.36
	$\bar{X}$	4.26	3.16	5.41	2.50	4.39	2.67	3.84
C	0	3.16	2.70	2.62	1.82	3.42	2.30	4.00
	2	2.72	2.50	2.84	2.28	3.70	2.90	3.64
	4	2.88	2.60	2.62	2.06	2.98	2.20	3.16
	8	3.14	2.36	2.96	1.64	3.30	2.08	2.92
	16	3.36	--	3.24	2.18	4.22	4.02	4.10
	$\bar{X}$	3.05	2.54	2.86	2.00	3.52	2.70	3.56
D	0	2.24	2.14	2.62	2.26	2.74	2.26	4.06
	2	2.28	2.48	3.02	2.26	3.58	1.92	4.00
	4	2.12	2.14	2.18	1.86	3.80	1.70	3.60
	8	3.02	1.70	2.10	2.10	3.02	1.62	2.82
	16	3.58	2.40	2.42	1.72	3.88	2.06	3.98
	24	4.10	3.84	6.44	1.82	3.62	2.40	5.10
	$\bar{X}$	2.89	2.45	3.13	2.00	3.44	1.99	3.93
E	0	2.84	2.78	2.44	2.10	3.20	2.22	3.52
F	0	3.26	3.64	3.80	1.88	2.20	2.02	3.78
	2	3.10	3.38	3.72	1.90	3.30	2.12	3.40
	4	3.24	2.80	4.26	1.36	2.80	2.00	3.16
	$\bar{X}$	3.20	3.27	3.93	1.71	2.77	2.05	3.45
G	0	2.84	3.16	2.72	1.01	3.50	2.56	3.90
	2	3.38	1.86	2.78	2.18	3.40	2.42	3.50
	4	2.78	1.98	2.90	2.04	3.30	2.30	2.90
	$\bar{X}$	3.00	2.33	2.80	1.74	3.40	2.43	3.43

*Dash (--) indicates no data for that date and depth.

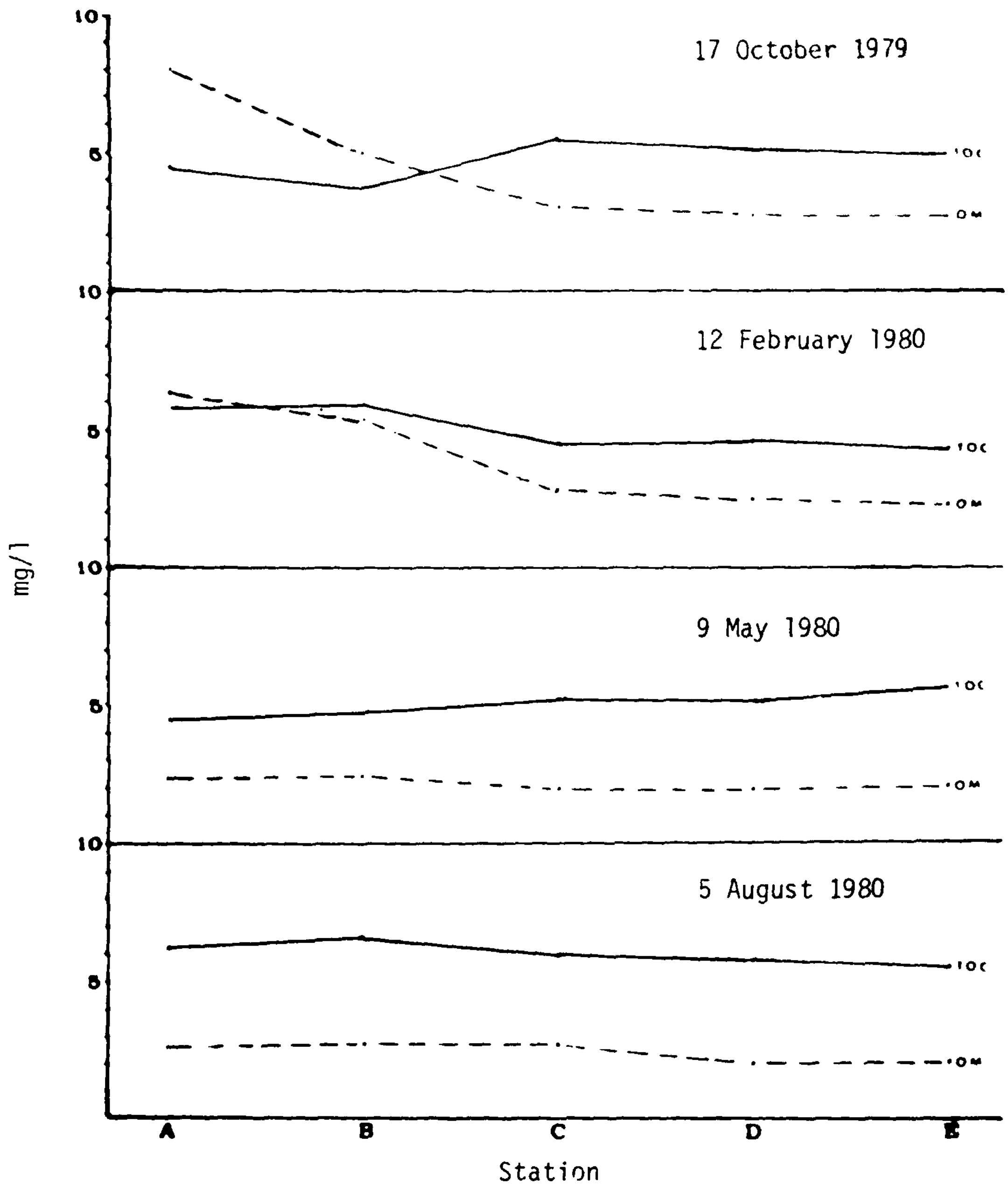


Figure 11. Suspended organic matter (OM) and total organic carbon (TOC) content of waters for selected dates at mainstream stations in West Point Lake.

Table 15

Total carbon concentration (mg/l) of water samples taken at each station and depth on all dates in West Point Lake during 1979-80.

Station	Depth (m)	17 Oct 79	5 Dec 79	12 Feb 80	19 Mar 80	9 May 80	5 Jun 80	5 Aug 80	4 Sept 80
					mg/l				
A	0	7.3	8.2	8.9	9.2	7.9	8.0	8.1	8.8
	2	7.5	8.4	8.2	9.4	7.5	8.1	9.5	9.3
	$\bar{X}$	7.4	8.3	8.6	9.3	7.7	8.1	9.4	9.1
B	0	7.6	7.4	8.5	8.6	8.0	6.8	10.2	10.1
	2	7.4	7.2	8.4	8.8	8.2	7.3	9.8	8.0
	4	7.5	7.3	8.4	8.9	7.4	7.6	10.5	10.0
	8	7.2	7.2	--*	9.0	7.3	8.2	9.6	9.9
	12	7.2	7.4	--	8.6	8.2	8.3	8.7	10.6
	$\bar{X}$	7.4	7.3	8.4	8.8	7.8	7.6	9.8	9.7
C	0	8.3	8.1	7.8	7.6	7.6	7.2	8.5	12.5
	2	8.6	8.4	7.7	8.1	7.5	7.6	9.0	10.9
	4	8.6	7.8	7.7	7.6	7.3	7.7	8.5	10.9
	8	8.7	8.0	7.7	7.5	8.0	8.1	8.8	11.1
	16	9.0	--	7.9	7.6	7.4	9.1	16.2	9.7
	$\bar{X}$	8.6	8.1	7.8	7.7	7.6	7.9	10.2	11.0
D	0	8.1	7.2	7.3	7.7	7.2	5.9	9.4	13.3
	2	8.0	7.1	8.1	7.4	7.1	7.3	7.5	12.0
	4	8.0	7.0	7.4	7.7	6.9	6.7	7.7	12.5
	8	7.9	7.2	7.2	7.9	7.4	7.3	7.3	11.8
	16	10.9	7.9	7.1	7.6	7.1	7.6	11.3	12.7
	24	9.2	6.8	7.1	7.6	8.3	8.4	14.0	16.0
	$\bar{X}$	8.7	7.2	7.4	7.7	7.3	7.2	9.5	13.1
E	0	8.3	7.3	7.0	7.7	8.4	6.9	9.1	12.2
F	0	8.3	7.9	6.7	7.1	7.2	5.9	7.5	11.5
	2	8.6	7.6	6.2	6.9	--	6.1	7.9	13.5
	4	8.5	7.6	6.2	6.6	--	6.8	8.3	12.7
	$\bar{X}$	8.5	7.7	6.4	6.9	7.2	6.3	7.9	12.6
G	0	9.3	8.4	7.8	7.1	7.5	6.8	9.0	13.1
	2	9.3	7.9	7.6	7.7	--	6.2	9.0	14.0
	4	8.6	8.0	8.0	8.3	--	7.5	8.9	13.1
	$\bar{X}$	9.1	8.1	7.8	7.7	7.5	6.8	9.0	13.4

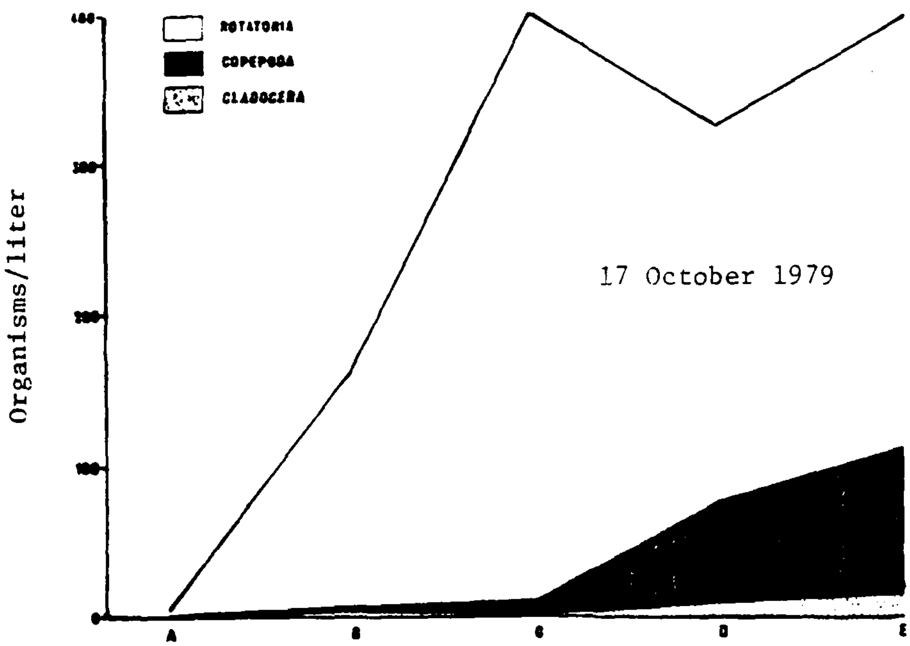
*Dash (--) indicates no data for that date and depth.

Table 16

Total organic carbon concentration (mg/l) of water samples taken at each station and depth on all dates in West Point Lake during 1979-80.

Station	Depth (m)	17 Oct 79	5 Dec 79	12 Feb 80	19 Mar 80	9 May 80	5 Jun 80	5 Aug 80	4 Sept 80
					mg/l				
A	0	4.8	5.0	4.0	3.5	3.1	4.4	5.9	6.6
	2	5.0	5.5	4.9	3.5	2.6	5.2	6.7	7.0
	$\overline{X}$	4.9	5.3	4.5	3.5	2.9	4.8	6.3	6.8
B	0	5.0	4.2	4.2	3.2	2.9	5.2	7.8	8.2
	2	4.7	3.7	4.1	2.7	3.0	5.1	8.1	5.8
	4	4.9	4.1	5.3	2.4	2.1	4.2	6.0	6.5
	8	4.6	3.9	--*	3.1	1.9	4.0	5.4	6.1
	12	4.6	4.2	--	2.8	2.9	4.7	4.8	7.0
	$\overline{X}$	4.8	4.0	4.5	2.8	2.6	4.6	6.4	6.7
C	0	5.9	5.0	4.5	1.9	5.2	5.5	6.7	10.5
	2	6.3	5.9	4.6	2.8	5.4	6.0	7.0	8.5
	4	6.3	5.0	4.4	2.2	5.5	4.9	6.3	8.4
	8	6.2	4.8	4.2	2.5	4.3	4.0	4.2	8.5
	16	6.1	--	4.8	2.5	3.9	4.8	6.0	5.7
	$\overline{X}$	6.2	5.2	4.5	2.4	4.9	5.0	6.0	8.3
D	0	5.4	4.7	4.6	2.6	5.0	4.3	7.2	11.1
	2	--	4.4	5.5	2.7	5.0	5.9	6.4	10.0
	4	5.3	4.5	4.9	3.1	4.9	5.0	6.5	10.3
	8	5.3	4.3	4.7	2.9	5.1	4.2	5.3	9.2
	16	8.1	4.9	3.7	2.8	3.4	3.8	5.9	7.5
	24	5.7	3.5	2.5	--	4.5	3.8	7.8	8.8
	$\overline{X}$	6.0	4.4	4.3	2.8	4.7	4.5	6.5	9.5
E	0	5.5	4.5	1.9	3.2	5.0	4.0	6.3	8.6
F	0	5.7	5.1	3.5	3.2	4.7	4.2	5.8	9.2
	2	6.0	4.8	2.6	2.9	--	4.3	6.0	11.3
	4	5.8	4.9	2.6	2.7	--	3.8	6.2	9.4
	$\overline{X}$	5.8	4.9	2.9	2.9	4.7	4.1	6.0	10.0
G	0	6.8	--	2.4	4.0	5.2	5.0	6.9	10.0
	2	6.7	4.5	2.0	3.1	--	4.4	6.7	11.2
	4	6.0	4.4	2.5	3.8	--	3.8	6.2	9.6
	$\overline{X}$	6.5	4.5	2.3	3.6	5.2	4.4	6.6	10.3

*Dash (--) indicates no data for that date and depth.



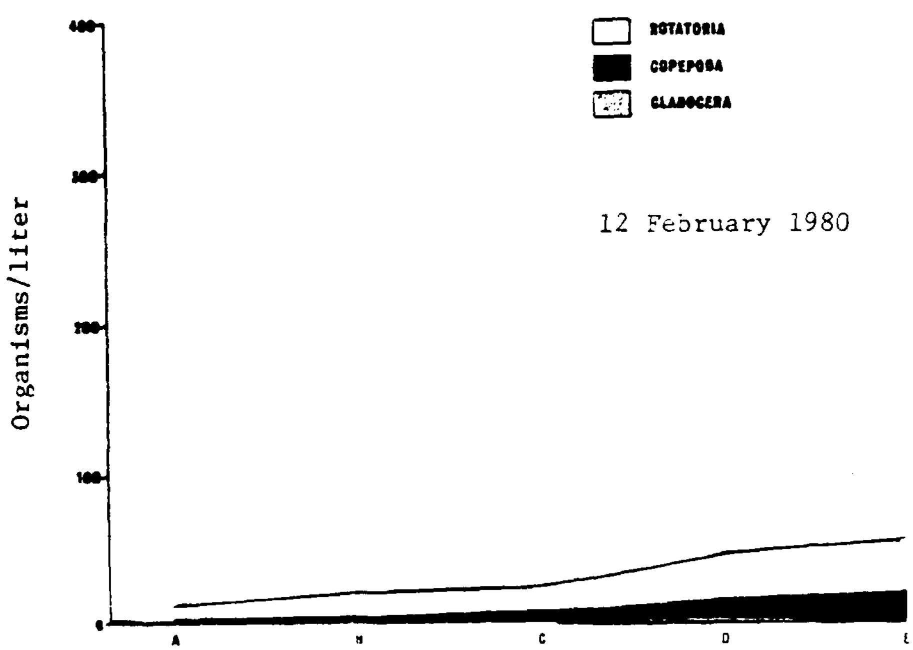
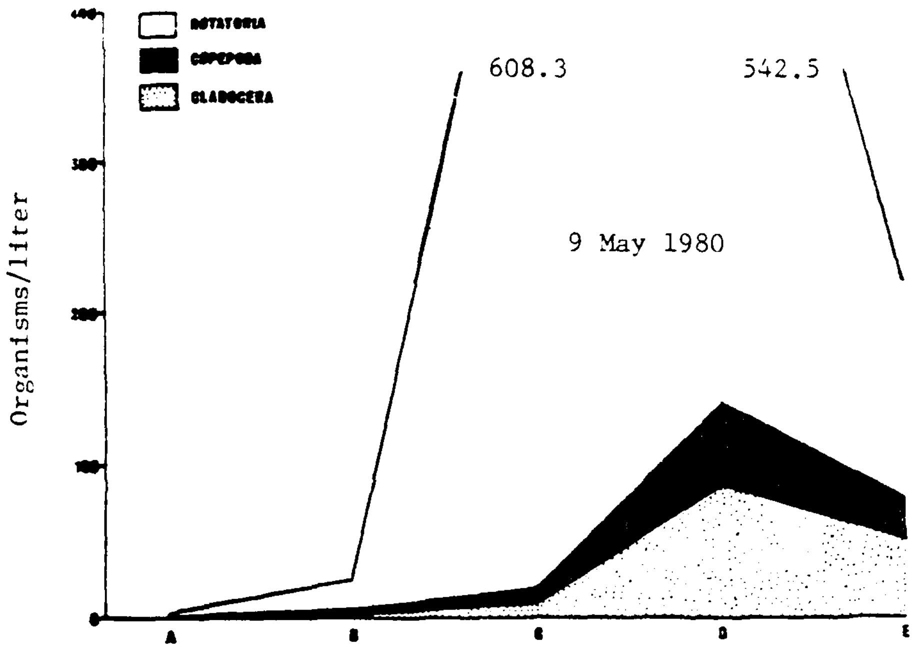


Figure 12. Zooplankton standing crop at mainstream sampling stations on West Point Lake on 17 October 1979 (upper) and 12 February 1980 (lower). Values represent means of all samples taken at all depths.



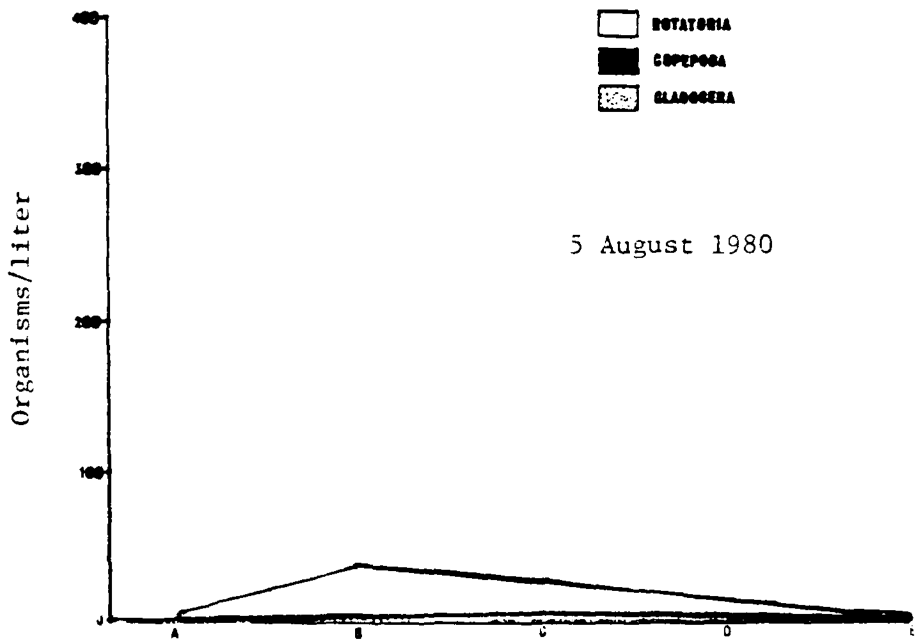


Figure 13. Zooplankton standing crop at mainstream sampling stations on West Point Lake on 9 May 1980 (upper) and 5 August 1980 (lower). Values represent means of all samples taken at all depths.

Table 17

Mean number of zooplankters (organisms/l) found in Yellowjacket and Wehadkee Creeks on all sampling dates during 1979-80.

Organism	1979 Oct	1980 Feb	1980 May	1980 Aug
	YELLOWJACKET CREEK (Station G)			
	organisms/l			
Rotatoria	466	66	456	16
Copepoda	18	13	35	7
Cladocera[1]	1	1	47	1
Total	485	80	538	24
	WEHADKEE CREEK (Station F)			
	organisms/l			
Rotatoria	367	16	124	17
Copepoda	36	9	133	8
Cladocera	4	2	16	2
Total	407	27	273	27

[1] Numbers include immature copepods.

Table 18

Mean number of zooplankters (organisms/l) for each station on all sampling dates during 1979-80.

Organism	A	B	C	D	E	F	G
	Stations						
	organisms/l						
Rotatoria	4	56	262	208	116	131	251
Copepoda[1]	1	4	8	35	37	47	18
Cladocera	1	1	3	24	16	6	12
Total	6	61	273	267	169	184	281

[1]Numbers include immature copepods.

Table 19

Mean number of zooplankters (organisms/l) from all stations for each date during 1979-80.

Organism	Oct 17	Feb 12	May 9	Aug 5
	Date			
	organisms/l			
Rotatoria	287	27	313	16
Copepoda[1]	30	10	42	4
Cladocera	4	1	32	1
Total	321	38	387	21

[1]Numbers include immature copepods.

73. Group Dominance. Rotifer density exhibited the highest annual mean values of the three major taxonomic groups of zooplankton. This was true at each station (Table 18) and for all dates (Table 19). Only the May sample collected from Wehadkee Creek had more copepods than rotifers (Table 17 and Appendix A, Table 5). Based on the annual mean density, rotifers were the most important component of the zooplankton community, followed in order by copepods and cladocera.

74. Species Dominance. The dominant genera and/or species collected at each station during the year are presented in Tables 20 and 21. Table 20 includes the two taxa numerically dominant at each station out of all major taxonomic groups. Table 21 includes the three taxa within each major group (Rotatoria, Copepoda, Cladocera) that were numerically dominant at each station.

75. When immature copepods (nauplii) are excluded, three species of rotifers dominated zooplankton collections at most stations in the lake. These three species that were either first or second in the dominance hierarchy (the August sample was an exception) were *Keratella cochlearis*, *Conochilus unicornis* and *Trichocerca cylindrica*. However, all but five of the 20 taxa of rotifers identified were either first or second on at least one date at one or more stations in the lake (Table 20). Cyclopoid copepods were second in the dominance hierarchy at two stations in August while the cladoceran, *Bosmina longirostris*, ranked second at one station in May.

76. The dominance hierarchy within each major group included the following taxa that usually dominated most collections (Table 21):

Rotatoria	*Brachionus calyciflorus*
	Conochilus unicornis
	Keratella cochlearis
	Polyarthra sp.
	Polyarthra vulgaris
	Synchaeta pectinata
	Trichocerca cylindrica
Copepoda	Calanoid copepods (adults)
	Cyclopoid copepods (adults)
	Nauplii (immature copepods)
Cladocera	*Bosmina longirostris*
	Bosminopsis deitersi
	Chydorus sphaericus
	Daphnia sp.
	Diaphansoma leuchtenbergianum

77. Diversity and Equitability. The mean number of zooplankters, number of taxa, diversity indices ($\bar{d}$) and equitabilities (e) for each station and date appear in Table 22. A comparison of these same values

Table 20

Dominance ranking of zooplankters (excluding nauplii) found on each sampling date in West Point Lake during 1979-80. Numbers indicate the two dominant species of zooplankters.

Organism	17 Oct 1979							12 Feb 1980							9 May 1980							5 Aug 1980						
	A	B	C	D	E	F	G	A	B	C	D	E	F	G	A	B	C	D	E	F	G	A	B	C	D	E	F	G
ROTATORIA																												
Hexarthra intermedia																												
Conochilus unicornis		1	1	2	1	2	1										1	1		1	1						2	
Keratella cochlearis	2		2	1	2	1	2	1	1	1	1	1	1	2	1	2			1		2							
Synchaeta pectinata										2			2	1														
Trichocerca cylindrica																				2				1	1	1	1	
T. porcellus																							2		2			
Collotheca sp.																												
Ploesoma truncatum																												
Polyarthra vulgaris											2	2				1		2										
Brachionus angularis																												
B. caudatus																							1					2
B. urceolaris	1	2																										
Kellicottia bostoniensis									2																			
Conochiloides coenobasis																												
C. dossuarius																								2				1
Philodina sp.																												
Rotaria sp.															2													
Bdelloid rotifer								2																				
Asplanchna priodonta																	2											
Ipochlanis propatula																						1						
COPEPODA																												
Cyclops sp.																												
Cyclopoid copepod																						2				2		
CLADOCERA																												
Bosmina longirostris																			2									

Table 21

Dominance ranking of zooplankters found on each sampling date in West Point Lake during 1979-80. Number indicates ranking of the three dominant species within each group.

[illegible]	17 Oct 1979							12 Feb 1980							9 May 1980							5 Aug 1980						
	A	B	C	D	E	F	G	A	B	C	D	E	F	G	A	B	C	D	E	F	G	A	B	C	D	E	F	G
ROTATORIA																												
Hexarthra sp.																												
H. intermedia																												
Conochilus unicornis		1	1	2	1	2	1										1	1	2	1	1						2	
C. hippocrepis																												
Keratella sp.																												
K. serrulata																												
K. earlinae																												
K. cochlearis	2	3	2	1	2	1	2	1	1	1	1	1	1	2	1	2		3	1		2					3		
[illegible] sp.																												
Synchaeta sp.																3												
S. pectinata									3	2	3		2	1														
Trichocerca sp.																												
T. cylindrica																				2				1	1	1	1	3
T. [illegible]																							2		2			
[illegible]																												
[illegible]																												
[illegible]																												
[illegible]																												
[illegible]					3																					2		
[illegible]																												
[illegible]				3		3	3																			3		
P. vulgaris										3	2	2	3	3		1	3	2	3		3							
[illegible]															3													
[illegible]																										3		
[illegible]																												
[illegible]																							1	3				2
[illegible]	1	2																										
[illegible]									2																			
A. [illegible]																											3	
A. [illegible]																	2			3								
[illegible]																												
[illegible]																												
[illegible]																							3	2	3			1
[illegible]																												
[illegible]								3																				
[illegible]																						1						
[illegible]																												
[illegible]								2							2							2						
[illegible]	1											3										3						

Table 21. Continued.

Organism	17 Oct 1979 A	B	C	D	E	F	G	12 Feb 1980 A	B	C	D	E	F	G	9 May 1980 A	B	C	D	E	F	G	5 Aug 1980 A	B	C	D	E	F	G
COPEPODA																												
Immature (nauplii)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1
Diaptomus sp.																												
Cyclops sp.																												
Cyclopoid copepod	2	2	2	2	2/3	2	3	2	2/3	2/3	2	2/3	2/3	2/3	3	2/3	2/3	2	3	2		1/3	2/3	2	2/3	2/3	2/3	2/3
Calanoid copepod						3		3			3		3		2		2		2	3	2							
Harpacticoid copepod				3			2																					
Unidentified copepod																												
CLADOCERA																												
Bosmina longirostris	1	1	1	1	1	1		1	1	1	1		1	2	1	1	1	1	1	1	1	2		2	1	1	2	2
Daphnia sp.	2							3	3									2	2	2/3	2/3							
D. pulex																												
D. parvula																												
Eurycercus lamellatus																												
Chydorus sphaericus								2	2	2	3	1	2	1	1	2						3						
Bosminopsis deitersi				3	3	3																	2	3	2		1	1
Ceriodaphnia sp.															3													
C. pulchella																												
C. lacustris						2	1									3												
Alona sp.																												
A. affinis																												
A. guttata																3												
A. quadrangularis																												
Pseudosida bidentata																												
Ilyocryptus sp.																												
I. acutifrons																												
I. sordidus																						1						
I. spinifer																												
Holopedium amazonicum						2										3			2									
Alonella sp.																												
A. acutirostris		3									2		3															
Sida crystallina					2												2											
Moina sp.																							1			2		
Moina micrura																												
Diaphanosoma sp.		2		2																								
D. brachyurum																												
D. leuchtenbergianum																		3					3	1	3		3	3
Scapholeberis sp.																3												
S. kingii																												
Dadaya macrops																												
Leydigia quadrangularis										3			2															
Kurzia latissima																												
Camptocercus rectirostris															2													
Immature cladoceran																			3									
Unidentified cladoceran																3												

Table 22

Number of zooplankters (excluding immature copepods), number of taxa, diversity ($\bar{d}$), and equitability (e) of zooplankton communities by station and date in West Point Lake during 1979-80.

Station	Month		Organisms/l	Taxa	d	e
A	Oct		4.01	21	2.70	0.43
	Feb		9.30	26	3.50	0.62
	May		1.59	28	3.68	0.68
	Aug		1.03	14	3.05	0.86
		$\bar{X}$	3.98	22.25	3.23	0.65
B	Oct		159.97	31	2.93	0.35
	Feb		18.23	30	3.09	0.40
	May		20.54	34	3.27	0.41
	Aug		33.74	22	2.61	0.36
		$\bar{X}$	58.12	29.25	2.98	0.38
C	Oct		402.26	16	1.99	0.31
	Feb		17.80	27	2.73	0.33
	May		618.54	21	2.29	0.33
	Aug		22.25	25	3.30	0.56
		$\bar{X}$	265.21	22.25	2.58	0.38
D	Oct		259.49	26	2.77	0.35
	Feb		34.16	25	2.96	0.44
	May		632.30	20	2.92	0.55
	Aug		11.06	22	1.85	0.23
		$\bar{X}$	234.26	23.25	2.63	0.39
E	Oct		316.63	22	3.22	0.59
	Feb		35.87	14	2.91	0.79
	May		202.96	18	3.08	0.67
	Aug		2.12	12	2.26	0.50
		$\bar{X}$	139.40	16.50	2.87	0.64
F	Oct		374.90	23	2.12	0.26
	Feb		18.06	24	2.17	0.25
	May		146.99	25	2.78	0.40
	Aug		19.86	22	3.34	0.68
		$\bar{X}$	139.96	23.50	2.60	0.40
G	Oct		468.24	23	2.42	0.30
	Feb		66.98	21	2.47	0.38
	May		505.32	21	2.75	0.43
	Aug		17.13	24	2.70	0.38
		$\bar{X}$	264.42	22.25	2.59	0.37

for 1976-80 appears in Table 23. During 1979-80 there were no significant changes (α = 0.05) in any of these means from the previous year (Table 23).

Table 23

Annual means of number of zooplankters[1], number of taxa, diversity ($\bar{d}$) and equitability (e) of zooplankton communities for all four sampling years on West Point Lake[2].

	Sampling year			
	1976-77	1977-78	1978-79	1979-80
Org/l	214.8±307.3 AB	227.3±262.5 A	95.2±111.5 B	157.9±204.4 AB
Taxa	13.7± 7.0 A	16.1± 6.4 A	23.9± 5.8 B	22.8± 5.0 B
$\bar{d}$	2.14± 0.59 A	2.67± 0.40 B	2.62± 0.67 B	2.78± 0.5 B
e	0.61± 0.33 A	0.65± 0.24 A	0.41± 0.20 B	0.46± 0.2 B

[1]Zooplankton densities do not include immature copepods.
[2]Means subtended by like letters are not significantly different ($p > 0.05$). Those subtended by unlike letters are significantly different ($p < 0.05$).

Aquatic Macrophytes

78. There were no notable increases in abundance of aquatic plants during 1979-80. Observations indicated a reduction in the area of coverage of the most abundant aquatic macrophytes, alligatorweed, *Alternanthera philoxeroides*, and smartweeds, *Polygonum* spp. This reduction may have resulted from the progressive lowering of the water level during the growing season.

Benthic Macroinvertebrates

Dredge (Grab) Samples

79. A total of 92 taxa were identified from dredge samples in the littoral areas of West Point Lake. Sixty-two of these taxa were members of one insect family, the dipteran family Chironomidae. The mean density of macroinvertebrates collected from dredge samples this year appears in Tables 24-27. Ten groups of macroinvertebrates numerically dominated the benthos in the dredge samples (Table 28). Of these 10 major groups, aquatic earthworms (Oligochaeta) and midge larvae (Chironomidae) usually dominated collections on most dates. Two families of oligochaetes were identified, Naididae and Tubificidae. Of those oligochaetes collected the tubificids comprised 90% of the total. Because of their importance in the grab samples, the percent composition of the common chironomid genera collected were reported in Table 29.

80. Mean values for density, number of taxa, diversity ($\bar{d}$) and equitability (e) by station and date for dredge samples collected during 1978-79 and 1979-80 appear in Table 30. Considerable variability was found in these samples between stations, seasons and years for each variable. No clear trend was detected except for station 12 located in the upper reaches of the reservoir where mean values for number of taxa and diversity were lower most of the year.

Artificial Substrate (Plate) Samples

81. A total of 89 taxa were identified from the Hester-Dendy multiple plate samplers used in West Point Lake. Sixty-one of these taxa were members of the family Chironomidae. Data on macroinvertebrate density for each station and date collected from the plate samplers are presented in Tables 31-34. Five groups of macroinvertebrates numerically dominated appproximately 98% of the benthos from the plate samples. These major groups included: Nematoda, Oligochaeta, Cladocera, Trichoptera and Chironomidae (Table 35). Of these five groups, the cladocerans and chironomids usually dominated collections on most dates. Two families of oligochaetes were identified as with the dredge samples, Naididae and Tubificidae. However, Naididae comprised 98% of the oligochaetes identified. The principal midge genera and their percent composition of the total chironomid fauna are reported in Table 36.

82. Mean values for density, number of taxa, diversity ($\bar{d}$) and equitability (e) by station and date for plate sampler collections during 1978-79 and 1979-80 are found in Table 37. In addition, bar graphs are presented for comparing density values for these two sample years (Figures 14-17). Figure 14 provides annual mean values only for 1979-80 since plate samplers were not used during all of 1978-79. Figures 15-17 provide seasonal comparisons between the two years.

Table 24

Mean number of macroinvertebrates (organisms/ft^2 = organisms/0.093 m^2) collected in dredge samples from each station in West Point Lake 16 September 1979.

Organism	Station 1 A	1 B	2 A	2 B	3 A	3 B	4 A	4 B	5 A	5 B	6 A	6 B	7 A	7 B	8 A	8 B	9 A	9 B	10 A	10 B	11 A	11 B	12 A	12 B	Total	$\bar{x}$	%
Nematoda	2	7	5	4			4			2		4						7			2		4	5	46	1.9	0.9
Oligochaeta																											
Naididae						128	21	14	18	7	57	21	11	7	43	7	142	164	14	2	18	14		43	731	30.5	14.3
Tubificidae	4	4	4	2	107	242	57	57	53	45	85	43	228	85	214	57	427	199	299	228	376	310	93	150	3369	140.4	66.0
Hirudinea																											
Cladocera				2			4	4																			
Copepoda	4																		7						17	0.7	0.3
Malacostraca																		7		2					13	0.5	0.2
Isopoda																											
Amphipoda																											
Decapoda																											
Collembola																											
Entomobryidae																											
Ephemeroptera																											
Caenidae																											
Caenis	43	29	4	2		29									14										121	5.0	2.4
Ephemerellidae																											
Ephemerella																											
Ephemeridae																											
Hexagenia		2					4								14										20	0.8	0.4
Unidentified															4										4	0.2	[illegible]
Odonata																											
Coenagrionidae																											
Argia																											
Gomphidae																											
Gomphus																											
Corduliidae																											
Plecoptera																											
Hemiptera																											
Corixidae																											
Megaloptera																											
Sialidae																											
Sialis																											
Tricoptera																											
Polycentropidae																											
Cyrnellus																											
Neureclipsis																											
Leptoceridae										4															4	0.2	1
Oecetis																											
Philopotamidae		2																							2	0.1	1
Chimarra																											
Hydroptilidae																											
Orthotrichia																											
Unidentified																											
Diptera																											
Chironomidae																											
Tanypodinae																											
Ablabesmyia																											
A. annulata																											
A. mallochi																				2					2	0.1	1
A. ornata						14	4					7		4		7									36	1.5	0.7
A. parajanta																											
A. tarella																											

Table 24. Continued.

Organism	Station	1		2		3		4		5		6		7		8		9		10		11		12				
	Sample Replicate	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	Total	$\bar{x}$	%
Tanypodinae, cont'd.																												
Anatopynia																												
Clinotanypus																												
C. [illegible]								2																		2	0.1	T
C. concinnus																												
C. [illegible]																												
[illegible]																												
Pentaneura																												
Procladius																					4	4	11			19	0.8	0.4
Psectrotanypus																												
Chironominae																												
Chironomini																												
Chironomus																												
Cryptochironomus		14	2	23	16		85	7	7	4			7	36	36	29	14	29	21	7		11	4			352	16.7	6.9
C. blarina																												
C. fulvus																												
C. spp.																												
Cryptotendipes											2		14									2			2	20	0.8	0.4
Dicrotendipes																												
D. lobus																												
D. nervosus																												
D. spp.																												
Einfeldia																												
Endochironomus																												
E. nigricans		2																								2	0.1	0.3
E. spp.																												
Glyptotendipes		2				14				7	14				11	29	50									127	5.3	2.5
Harnischia																					2					2	0.1	0.3
Parachironomus																												
P. directus																												
P. [illegible]		5																								5	0.2	0.1
P. pectinatellae				4	4																					8	0.3	0.2
P. spp.																												
Paracladopelma																												
Paratendipes connectens																												
Polypedilum																												
P. braseniae																												
P. convictum																												
P. halterale																												
P. illinoense		2	4								2				4				7			9				28	1.2	0.5
P. spp.																												
Pseudochironomus		4																								4	0.2	T
Stenochironomus																												
Xenochironomus				2																						2	0.1	0.3
Tanytarsini																												
Cladotanytarsus											2															2	0.1	T
Rheotanytarsus																												
Tanytarsus		11	9	4	6	7				4				4								2	7			53	2.2	1.0

Table 24. Continued.

Organism	Station / Sample Peplicate	1 A	1 B	2 A	2 B	3 A	3 B	4 A	4 B	5 A	5 B	6 A	6 B	7 A	7 B	8 A	8 B	9 A	9 B	10 A	10 B	11 A	11 B	12 A	12 B	Total	$\bar{x}$	%
Chironomidae, cont'd.																												
Orthocladiinae																												
Brillia																												
Corynoneura																												
Cricotopus		2																								2	0.1	1
Eukiefferella																												
E. cerulescens																												
Psectrocladius																												
Rheocricotopus																												
Smittia																												
Chironomid pupae		2	2		2			2						4												12	0.5	1.8
Unidentified											2															2	0.1	0.3
Chaoboridae																												
Chaoborus																												
Chaoborid pupae																						2			2	4	0.2	1
Ceratopogonidae		4	2		4		14				4					14										42	1.8	0.8
Simuliidae																												
Hymenoptera																												
Ichneumonidae																												
Hydracarina																	7		7	7		5		4	2	32	1.3	0.6
Mollusca																												
Gastropoda																												
Pelecypoda																												
Corbicula				4	5											14										23	1.0	0.5
TOTAL		101	63	59	46	120	512	105	82	86	84	142	96	203	147	375	142	598	412	334	240	431	346	101	204	5108		

*T = trace.

Table 25

Mean number of macroinvertebrates (organisms/ft^2 = organisms/0.093 m^2) collected in dredge samples from each station in West Point Lake 7 December 1979.

Organism	Station	1		2		3		4		5		6		7		8		9		10		11		12				
	Sample Replicate	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	Total	$\bar{x}$	%
Nematoda					2			7				2	2			4		2	2	7						28	1.2	0.3
Oligochaeta																												
Naididae		21	2	12	14	7		23	12	18	21		5	21	25	37		48	9		4		25	36	30	370	15.4	4.0
Tubificidae		313	11	98	89	71	27	130	141	139	265	68	160	150	174	194		231	205	64	62	85	75	335	311	3398	141.6	36.8
Hirudinea													2													2	0.08	T
[illegible]		14	4	5	11	28	9	5	14	7	11		23	43	71	11		4	5	18	5	14	7			309	12.9	3.4
[illegible]		43	2	18	34	221	21	5	7	2		21	68	85	14	21		59	69			14				704	29.3	7.7
[illegible]																												
[illegible]																												
[illegible]																												
[illegible]																												
Collembola																												
Entomobryidae																												
Ephemeroptera																												
Caenidae																												
Caenis				2				5	5	21	32	2				4		4	5	14	7					101	4.2	1.1
Ephemerellidae																												
Ephemerella																												
Ephemeridae																												
Hexagenia					5	28					2		2			18		2								57	2.4	0.6
[illegible]																												
[illegible]																												
[illegible]																												
[illegible]																												
[illegible]																												
[illegible]																												
[illegible]																					4					4	0.2	T*
[illegible]																												
[illegible]																												
[illegible]																												
[illegible]																												
[illegible]																												
[illegible]																												
[illegible]																												
[illegible]																												
[illegible]																												
[illegible]													2													2	0.08	T
[illegible]																												
[illegible]				5	9		4	11	5	4	2	5	16			7										68	2.8	0.7
[illegible]																												
[illegible]																												
[illegible]																												
[illegible]																												
[illegible]								2																		2	0.08	T
Diptera																												
Chironomidae																												
Tanypodinae																												
Ablabesmyia																												
A. annulata																												
A. mallochi																												
A. ornata																												
A. parajanta																												
A. tarella																												

Table 25. Continued.

Station	1		2		3		4		5		6		7		8		9		10		11		12				
Sample Replicate	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	Total	x	[illegible]
Tanypodinae, cont'd																											
Anatopynia																											
Clinotanypus																											
Coelotanypus																											
C. concinnus			4		7							5													16	0.7	0.2
C. scapularis				12	7		4						28	14							21	7			93	3.9	1.0
[illegible]				4																					4	0.2	1
[illegible]				12	14												2								28	1.2	0.3
Psectrotanypus				4	14									14	7			2	7	28	78	100			254	10.6	2.8
Chironominae																											
Chironomini																											
[illegible]					7	7		2	2	4	12							2			7				43	1.8	0.5
[illegible]	36	41	22	[illegible]			9	36	18	36	18	14	28		50				4						333	13.9	3.6
[illegible]	43		20	[illegible]		4	9	20	5	16	12	50	28	43	43	7		11	16	18					363	15.1	3.9
[illegible]											4														4	0.2	0.2
[illegible]																		4	7	2					13	0.5	0.1
[illegible]					2			2	2	7					7										25	1.0	0.3
[illegible]													43	43	11		4	2			7				110	4.6	1.2
[illegible]	7	[illegible]	[illegible]	[illegible]	[illegible]	25	4		14		12	36	114	100	28		4								525	21.9	5.7
[illegible]							2																		2	0.08	1
[illegible]					7						4	6													16	0.7	0.2
[illegible]											4		28												32	1.3	0.3
P. illinoense													14	43			2		4						63	2.6	0.7
Pseudochironomus																											
Stenochironomus																											
Xenochironomus																											
Tanytarsini																											
[illegible]																	2		4						6	0.2	0.3
[illegible]										12	9		14						4	5					44	1.8	[illegible]
[illegible]			5		5		7	2	4	11	4	11	28	14			4	4	4	7					164	6.4	1.7

Table 25. Continued.

Taxa / Station	1 A	1 B	2 A	2 B	3 A	3 B	4 A	4 B	5 A	5 B	6 A	6 B	7 A	7 B	8 A	8 B	9 A	9 B	10 A	10 B	11 A	11 B	12 A	12 B	Total	x	%
[illegible], cont'd																											
[illegible]														14					4						18	[illegible]	[illegible]
Rheocricotopus																											
Chironomid pupae																											
Unidentified																											
Chaoboridae					7							5	14	14											40	1.7	0.4
Chaoborid pupae														14			2		18	5	21	64			124	5.2	1.3
Ceratopogonidae	14		5	9	14		11	7						28	25		14	5	46	64		14			256	10.6	2.8
[illegible]	7	4	18	9		4	12	9		7	34	14			14		9	2	32	16					191	7.9	2.1
[illegible]	21	128	89	93	64	114	30	36	356	333			14	14	25		16	75	7	16					1433	59.7	15.5
[illegible]	519	235	[illegible]	[illegible]	[illegible]	265	274	309	592	759	211	420	652	639	[illegible]	7	409	402	262	245	247	292	371	341	9235		

* T = trace.

Table 26

Mean number of macroinvertebrates (organisms/ft^2 = organisms/0.093 m^2) collected in dredge samples from each station in West Point Lake 19 March 1980.

Station	1		2		3		4		5		6		7		8		9		10		11		12				
Sample [illegible]	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	Total	x̄	%
[illegible]					18	50		4	2	4	16	28	21		21	7	13	7	2	5	7	2	2		209	8.2	4.6
Oligochaeta																											
Naididae		2			14	28			4	11		2	130		9		5		11		20	4	9	4	253	10.5	5.5
Tubificidae	7	37	2	4	246	591	41	45	45	55	14	21	689	59	276	263	68	37	117	126	91	66	50	91	3041	126.7	66.2
Hirudinea																											
Cladocera	7		2			7			5																21	0.9	0.5
Copepoda	2		4		4	7		2	2		2	2								4					29	1.2	0.6
Malacostraca																											
Isopoda																											
[illegible]																											
[illegible]																											
Collembola			4						2											2					8	0.3	0.2
Entomobryidae																											
Ephemeroptera																											
[illegible]																											
[illegible]									2		4	2			7				2						17	0.7	0.4
Ephemerellidae																											
[illegible]																											
[illegible]																											
[illegible]						7					2														9	0.4	0.2
[illegible]																											
[illegible]																											
[illegible]																											
[illegible]																											
[illegible]																											
[illegible]						4	7		2				7		7										27	1.1	0.6
[illegible]																											
[illegible]																											
Orthotrichia																											
Unidentified																											
Diptera																											
Chironomidae																											
[illegible]																											
Ablabesmyia																											
A. [illegible]																					2				2	0.08	t*
A. mallochi																											
A. [illegible]																											
A. parajanta											2														2	0.08	0.1
A. tarella																											

Table [illegible]6. Continued.

Species	Station	1		2		3		4		5		6		7		8		9		10		11		12				
	Sample replicate	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	Total	x	%
[illegible]																												
[illegible]																												
Clinotanypus																												
[illegible]																												
[illegible]																												
[illegible]																												
[illegible]																												
[illegible]																												
Psectrotanypus			2				17			4	2	2														26	1.1	0.[illegible]
[illegible]																												
Chironomini		2	2											7								2				13	0.5	0.3
Chironomus		5		2			7					5										2				21	0.9	0.5
Cryptochironomus		2	7			11	21		2		2	2	2	36								4	2			91	3.8	2.0
C. [illegible]																												
C. fulvus																												
[illegible]																												
Cryptotendipes																						4				4	0.2	1
[illegible]						4																				4	0.2	1
[illegible]																												
[illegible]																												
[illegible]																												
[illegible]																												
[illegible]																												
[illegible]																												
[illegible]																												
[illegible]				2	2				2		9								2							17	0.7	0.4
[illegible]																												
[illegible]																												
[illegible]																												
[illegible]																												
[illegible]																												
[illegible]																												
[illegible]							7			2																9	0.4	0.[illegible]
[illegible]																								2		2	0.08	0.3
[illegible]																												
[illegible]																												
[illegible]																												
P. [illegible]														71		57	114	4				23	7			276	11.5	6.0
[illegible]																												
[illegible]									4	4																8	0.3	0.2
[illegible]													2													2	0.08	1
[illegible]																												
[illegible]																												
[illegible]					2						2			7				2								13	0.5	0.3
Cladotanytarsus				5		4				11	5					7	21	7	2			2	4			68	2.8	1.5
[illegible]																						2				2	0.08	0.3
Tanytarsus		16	5	12	12	11	43	4	4	11	16	5		14	4	7		5	4			4				179	7.5	3.9

Table 26. Continued.

Organism	1 A	1 B	2 A	2 B	3 A	3 B	4 A	4 B	5 A	5 B	6 A	6 B	7 A	7 B	8 A	8 B	9 A	9 B	10 A	10 B	11 A	11 B	12 A	12 B	Total	$\bar{x}$	%
Chironomidae, cont'd.																											
Orthocladiinae																											
Brillia																					2	2			4	0.2	0.5
Corynoneura																											
Cricotopus																											
Eukiefferella																											
E. cerulescens																											
Psectrocladius																											
Rheocricotopus																							2		2	0.08	0.3
Smittia																											
Chironomid pupae																											
Unidentified																											
Chaoboridae				2		7						2	7			7					2	2			29	1.2	[illegible]
Chaoborus		2																	2		2				6	0.25	0.1
Chaoborid pupae																											
Ceratopogonidae																											
Simuliidae				2	21	14				2	2	2	36			7	2				9	11	2		110	4.6	2.4
Plecoptera																											
Isoperla																											
Hydracarina			2	2							7	9						2							22	0.9	0.5
Mollusca																											
Gastropoda																											
Pelecypoda																											
Corbicula			7	2	4	14	2						14		21										64	2.7	1.4
Total	43	57	42	23	311	824	47	63	96	108	61	74	1039	63	412	419	106	56	134	137	176	102	67	95	4590		

*T = trace.

Table 27

Mean number of macroinvertebrates (organisms/ft^2 = organisms/0.093 m^2) collected in dredge samples from each station in West Point Lake 6 June 1980.

[illegible]	Station 1		2		3		4		5		6		7		8		9		10		11		12				
Grab Replicate	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	Total	x	[illegible]
Nematoda	21	32	2	2	78	5	5	4	25	5			4	5	28	5	53	20	5	11	14	5	21	4	354	14.8	5.[illegible]
Oligochaeta																											
Naididae					21				57		4	4			2		14	11		4	4				121	5.0	1.[illegible]
Tubificidae	36	287	55	25	142	126	18	30	424	109	117	50	142	146	125	133	331	132	87	64	144	46	150	73	2992	124.7	42.9
Hirudinea			2	2																					4	0.2	[illegible]
Cla[illegible]				4	7		4	4					5	2	5	5	4		16	20	43	9	36	11	175	7.3	[illegible].5
Copepoda	7	23	4	5	14			2	7					4	59	21	7				4	2			159	6.6	2.3
[illegible]																											
[illegible]																											
A[illegible]																											
Decapoda																											
Collembola																											
Entomobryidae																											
Ephemeroptera																											
Caenidae																											
Caenis			4			9		2																	15	0.6	0.2
Ephemerellidae																											
Ephemerella																											
Ephemeridae																											
Hexagenia	7				7		2		11				2	2	7	20	4	9							71	3.0	1.0
Unidentified																											
Odonata																											
Coenagrionidae																											
Argia																											
[illegible]																											
[illegible]																											
[illegible]																											
[illegible]																											
[illegible]																											
[illegible]																											
[illegible]																											
[illegible]																											
[illegible]											7														7	0.3	0.1
Tri[illegible]																											
[illegible]																											
[illegible]																											
[illegible]																											
[illegible]																											
[illegible]			2	[illegible]	7			5				4		2											25	1.0	0.4
[illegible]																											
[illegible]																											
[illegible]																											
[illegible]																											
[illegible]																											
[illegible]																											
Ch[illegible]																											
[illegible]					7							4		4							4				19	0.8	0.7
[illegible]																											
A. [illegible]																											
A. [illegible]						2																			2	0.08	1*
A. [illegible]																											
A. parajanta																											
A. tarella																											

Table 27. Continued.

Organism	Station 1 A	1 B	2 A	2 B	3 A	3 B	4 A	4 B	5 A	5 B	6 A	6 B	7 A	7 B	8 A	8 B	9 A	9 B	10 A	10 B	11 A	11 B	12 A	12 B	Total	x	%
Tanypodinae, cont'd.																											
Anatopynia																											
Clinotanypus																											
Coelotanypus																											
C. concinnus																											
C. scapularis																											
Nilotanypus																											
Pentaneura	7				7						4														18	0.8	0.3
Procladius			7		7	4				5	4	4	4			11		7	5	18				2	78	3.3	1.1
Psectrotanypus																											
Chironominae																											
Chironomini				7				2			4	4			11			20				5			53	2.2	0.8
Chironomus										5					11	5						30	7		58	2.4	0.8
Cryptochironomus	11	5	14	14	7				43	14			11	12	16	27	25	12	2	9	62	30			314	13.1	4.5
C. blarina																											
C. fulvus																											
C. spp.																											
Cryptotendipes				7	7					14		11		4		5	75	25	4	5					157	6.5	2.3
Dicrotendipes																											
D. lobus																											
D. nervosus				7														7							14	0.6	0.3
D. spp.																		7							7	0.3	0.2
Einfeldia			7						14																21	0.9	0.8
Endochironomus																											
E. nigricans																											
E. spp.																											
Glyptotendipes			14	14	7						14	11			5		25	7							97	4.0	1.4
Harnischia																											
Parachironomus																											
P. directus																											
P. monochromus	7	5	7	20		7			14				4		25		12			12	12	11			136	5.7	1.9
P. pectinatellae		5				2		2			4			4											17	0.7	0.2
P. spp.	28	20	7						14	18			34	20	14	11						5		2	173	7.2	2.5
Paracladopelma		5				2		2	14	5			4												32	1.3	0.4
Paratendipes connectens																											
Polypedilum																											
P. braseniae																											
P. convictum																											
P. halterale	11	5	28	20			5	2								16	14								101	4.2	1.5
P. illinoense																											
P. spp.														4					2	23	9	11	7	2	58	2.4	0.8
Pseudochironomus																											
Stenochironomus																											
Xenochironomus																											
Tanytarsini			14		7						4	11			11		14								61	2.5	0.9
Cladotanytarsus			21	20		14	23	4	14	44					5	5	25					5			180	7.5	2.6
Rheotanytarsus																											
Tanytarsus	14	77	57	34	78	9	28	7	267	9	68	11	37	36	25	36	125	57	14		12	11			1012	42.2	14.5

Table 27. Continued.

Organism	Station / Sample Replicate	1 A	1 B	2 A	2 B	3 A	3 B	4 A	4 B	5 A	5 B	6 A	6 B	7 A	7 B	8 A	8 B	9 A	9 B	10 A	10 B	11 A	11 B	12 A	12 B	Total	x̄	%
Chironomidae, cont'd.																												
Orthocladiinae																												
Brillia																					4					4	0.2	0.2
Corynoneura																												
Cricotopus																												
Eukiefferella					29	7		4												4	4	9	20	7		82	3.4	1.2
E. cerulescens																												
Psectrocladius																												
Rheocricotopus																												
Smittia																												
Chironomid pupae																												
Unidentified		5	21	5	2	5	5	11	11		21	28	5	5	7	9	28	12	5		2					187	7.8	2.7
Chaoboridae								5				4														9	0.4	0.1
Chaoborus																												
Chaoborid pupae																						4	2			6	0.3	0.1
Ceratopogonidae																												
Simuliidae		7	20			14	2			4				2		4	2			2	4	5	2	7		75	3.1	1.1
Hymenoptera																												
Ichneumonidae																												
Hydracarina																												
Mollusca				11	5	7	2	2			4		4		2	4		4	2	2		2				51	2.1	0.7
Gastropoda																												
Pelecypoda																												
Corbicula		4	2		2						11			2				7					2			30	1.3	0.4
Total		160	491	277	225	433	189	101	77	919	243	255	146	256	252	364	311	767	328	148	178	330	196	236	91	6975		

*T = trace.

Table 28

Percent composition of the ten major groups of organisms identified from dredge samples from May 1978 to June 1980.

Taxon	May	June		July	Aug	Sept	Dec		Mar	
	1978	1979	1980	1978	1978	1979	1978	1979	1979	1980
Nematoda	T*	2.4	5.1	0.2	0.5	0.9	0.4	0.3	0.8	4.6
Oligochaeta	60.6	39.4	44.6	56.4	63.5	80.3	46.2	40.8	37.8	71.8
Cladocera	0.6	2.4	2.5	0.6	0.2	0.3	1.5	3.4	0.4	0.5
Copepoda	11.8	5.4	2.3	8.3	4.5	0.2	10.3	7.7	1.8	0.6
Ephemeroptera	T	T	1.2	0.6	0.5	2.8	0.8	1.7	0.4	0.6
Trichoptera	0.2	1.4	0.4	0.6	0.2	0.1	0.2	0.8	0.8	0.6
Chironomidae	22.6	46.3	41.4	15.9	17.6	13.3	35.5	23.6	41.2	16.2
Chaoboridae	3.2	T	0.1	16.8	12.1	T	1.1	1.3	8.2	0.1
Ceratopogonidae	0.3	T	1.1	0.4	0.4	0.8	2.0	2.8	4.5	2.4
Pelecypoda	T	T	0.4	T	0.4	0.5	1.7	15.5	0.0	1.4

*Denotes trace (< 0.1)

Table 29

Percent composition of the nine dominant genera of the family Chironomidae collected from dredge samples from May 1978 to June 1980.

Taxon	May	June		July	Aug	Sept	Dec		Mar	
	1978	1979	1980	1978	1978	1979	1978	1979	1979	1980
Coelotanypus	0.6	0.2	0.0	1.7	4.2	0.3	18.6	5.3	14.0	0.0
Procladius	14.9	11.4	2.9	18.9	20.9	2.8	3.1	11.8	29.5	3.5
Chironomus	11.7	5.2	2.2	2.8	1.9	0.0	47.3	15.5	20.9	2.8
Cryptochironomus	11.7	12.7	11.7	15.3	24.0	52.7	10.4	16.9	0.0	12.2
Glyptotendipes	12.4	19.1	3.6	20.4	21.9	19.0	9.0	1.2	9.4	2.3
Parachironomus	4.0	2.9	12.1	6.0	2.6	2.0	0.0	29.7	0.0	0.0
Polypedilum	11.3	6.4	5.9	7.3	0.4	4.2	1.6	4.4	2.7	37.0
Cladotanytarsus	10.5	5.5	6.7	1.7	4.3	0.3	0.0	2.1	0.0	9.1
Tanytarsus	13.1	25.8	37.6	16.6	11.6	7.9	0.0	7.2	10.1	24.0
Total percentage of composition	90.2	89.2	82.7	90.7	91.8	89.2	90.0	94.1	86.6	90.9

Table 30

Mean density, number of taxa, diversity ($\bar{d}$) and equitability (e) of macroinvertebrates collected from dredge samples for each sampling period during 1978-79 and 1979-80.

Station	Month[1]	Organisms/ft^2		Taxa		$\bar{d}$		e	
		78-79	79-80	78-79	79-80	78-79	79-80	78-79	79-80
1	A-S	56.5	32.0	9	15	2.59	2.36	0.56	0.69
	D	113.0	377.0	10	19	2.32	2.54	0.70	0.80
	M	220.0	50.0	13	12	3.22	2.44	1.18	0.70
	J	214.0	325.5	13	15	3.27	2.50	0.73	0.53
2	A-S	142.0	48.0	8	11	1.61	1.83	0.60	0.91
	D	147.0	353.0	8	20	1.39	1.20	0.62	0.70
	M	130.0	35.0	10	13	2.45	1.16	0.58	1.00
	J	211.0	251.0	22	24	3.30	3.39	0.64	0.92
3	A-S	225.0	320.0	9	3	2.11	1.96	0.73	0.62
	D	163.0	423.0	10	20	2.34	2.17	1.10	0.66
	M	252.0	582.5	15	17	3.61	1.83	1.13	0.29
	J	202.0	311.0	13	25	3.47	3.09	0.84	0.48
4	A-S	310.0	95.5	10	3	1.57	1.92	0.35	0.56
	D	238.0	297.0	11	13	2.38	2.36	1.00	0.53
	M	202.0	55.0	12	3	2.97	1.00	0.92	0.38
	J	187.0	36.5	13	17	3.48	3.16	0.39	0.75
5	A-S	206.0	85.0	9	12	1.72	2.12	0.60	0.50
	D	89.0	575.5	9	15	2.13	2.09	0.67	0.38
	M	284.0	102.0	13	17	3.13	2.72	0.92	0.53
	J	166.0	581.0	18	19	3.29	2.62	0.78	0.42
6	A-S	182.0	119.0	8	6	2.10	1.65	0.74	0.67
	D	366.0	315.5	12	22	2.26	3.20	0.60	0.59
	M	138.0	67.5	11	15	2.60	2.94	0.73	0.73
	J	208.0	200.5	17	16	2.77	2.77	0.59	0.56
7	A-S	262.0	215.0	6	8	1.11	1.04	0.41	0.38
	D	336.0	545.5	11	13	2.30	2.59	0.54	0.39
	M	415.0	551.0	8	12	2.95	1.79	0.25	0.23
	J	295.0	254.0	17	20	2.53	2.32	0.47	0.35
8	A-S	268.5	259.5	5	11	1.21	2.11	0.40	0.64
	D	378.0	256.5	10	17	2.47	2.21	0.60	0.75
	M	170.0	415.5	9	11	2.57	1.72	0.39	0.36
	J	732.0	337.5	18	21	3.36	3.30	0.67	0.67
9	A-S	256.5	505.0	8	7	1.32	1.36	0.59	0.43
	D	460.0	405.5	9	21	1.75	2.34	0.44	0.33
	M	868.0	81.0	11	11	2.50	1.32	[illegible]	0.45
	J	357.0	547.0	16	21	3.48	2.39	[illegible]	0.32
10	A-S	264.5	287.0	8	7	1.13	1.62	[illegible]	[illegible]
	D	112.0	253.5	2	19	0.34	1.39	0.50	0.79
	M	154.0	135.5	4	7	1.40	1.71	0.75	0.29
	J	500.0	162.7	14	15	2.73	2.34	0.64	0.67
11	A-S	152.5	388.5	9	10	1.75	1.83	0.47	0.20
	D	115.0	263.5	6	12	1.68	2.51	0.67	0.80
	M	426.0	139.0	9	16	1.38	2.40	0.56	0.44
	J	779.0	263.0	10	20	1.73	3.13	0.40	0.50
12	A-S	126.5	152.5	3	6	0.46	1.02	0.38	0.33
	D	33.0	356.0	4	1	1.69	1.44	1.00	1.00
	M	25.0	81.0	2	6	1.53	1.73	1.00	0.33
	J	134.0	164.5	3	9	0.52	1.65	0.67	0.44
$\bar{x}$	A-S	255.0	213.0	8	9	1.61	1.74	0.54	0.51
	D	196.0	385.0	8	15	2.07	2.11	[illegible]	0.68
	M	279.0	191.0	11	12	2.74	1.93	0.60	0.49
	J	350.0	290.0	16	18	2.91	2.36	0.70	0.58

[1]Months: A-S, August-September; D, December; M, March; J, June.

Table 31

Mean number of macroinvertebrates (organisms/ft^2 = organisms/0.093 m^2) collected from plate samples taken at stations 1-11 in West Point Lake 4 October 1979.[1]

Organism	Station	1	2	3	4	5	6	7	8	9	10	11	Total	$\bar{x}$	%
Nematoda					0.3			1.0		0.5			1.8	0.2	T*
Oligochaeta															
Naididae								6.0			2.0		8.0	0.8	T
Tubificidae															
Hirudinea															
Cladocera		434.0	529.0	193.0	134.0	1093.0	1804.0	116.0	2379.0	1872.0	156.0		8710.0	871.0	84.3
Copepoda															
Collembola															
Entomobryidae															
Ephemeroptera															
Caenidae															
Caenis															
Ephemerellidae															
Ephemerella															
Heptageniidae															
Stenonema		1.0											1.0	0.1	T
Leptophlebiidae															
Leptophlebia															
Siphlonuridae															
Isonychia															
Tricorythidae															
Tricorythodes															
Unidentified															
Odonata															
Coenagrionidae															
Argia															
Coleoptera															
Elmidae															
Trichoptera															
Leptoceridae															
Oecetis															
Hydropsychidae															
Hydropsyche															
Macronema															
Hydroptilidae															
Hydroptila															
Orthotrichia		1.0									2.0		3.0	0.3	T
Philopotamidae															
Chimarra															
Polycentropodidae															
Cyrnellus		39.0	6.0	8.0	3.0	20.0	7.0	0.8	4.0	6.0	1.0		94.8	9.5	0.9
Neureclipsis															
Unidentified		27.0	16.0	7.0	11.0	45.0	2.0	5.0	5.0				118.0	11.8	1.1
Trichopteran pupae		0.3	6.0				0.3	0.5		0.5			7.6	0.8	T
Trichopteran adult											0.3		0.3	T	T

Table 31. Continued.

Organism	Station 1	2	3	4	5	6	7	8	9	10	11	Total	x	%
Diptera														
Chironomidae														
Tanypodinae														
Ablabesmyia	5.0											5.0	0.5	0.4
A. annulata	0.3							0.3				0.6	T	T
A. mallochi						1.0		0.5		0.3		1.8	0.2	T
A. ornata														
A. parajanta														
A. tarella														
Clinotanypus														
Coelotanypus														
C. concinnus														
C. scapularis														
C. spp.														
Procladius														
Chironominae														
Chironomini	9.0	1.0	8.0	1.0		8.0	7.0		4.0	1.0		39.0	3.9	0.4
Chironomus														
Cryptochironomus														
C. blarina														
C. fulvus														
C. spp.														
Cryptotendipes														
Dicrotendipes	178.0	174.0	12.0	58.0	33.0	13.0	57.0	36.0	8.0	3.0		572.0	57.2	5.5
D. lobus														
D. nervosus														
Endochironomus														
E. nigricans														
E. spp.														
Glyptotendipes	155.0	84.0	35.0	73.0	61.0	47.0	19.0	90.0	95.0	5.0		664.0	66.4	6.4
Harnischia														
Nilothauma														
Parachironomus														
P. carinatus														
P. directus														
P. monochromus	0.8	1.0		4.0		9.0				0.3		15.1	1.5	0.1
P. pectinatellae														
Paracladopelma														
Polypedilum														
P. convictum														
P. halterale														
P. illinoense														
P. spp.														
Pseudochironomus														
Tribelos														
Xenochironomus														

Table 31. Continued.

Organism	Station	1	2	3	4	5	6	7	8	9	10	11	Total	x	%
Chironomidae (cont'd)															
Tanytarsini		14.0	2.0										16.0	1.6	0.[illegible]
Cladotanytarsus															
Micropsectra									0.5		0.3		0.8	T	T
Paratanytarsus		3.0											3.0	0.3	0.2
Tanytarsus		5.0											5.0	0.5	T
Orthocladiinae															
Brillia								1.0					1.0	0.1	0.1
Corynoneura															
Cricotopus		6.0						1.0					7.0	0.7	T
C. bicinctus															
C. sp. I															
Eukiefferiella cerulescens															
Psectrocladius									1.0				1.0	0.1	0.1
P. vernalis		7.0	2.0												
P. sp.											0.5		9.5	0.9	0.1
Paracricotopus															
Thienemanniella															
Unidentified						0.3							0.3	T	T
Chironomid pupae										2.0			2.0	0.2	T
Chironomid adult		5.0	1.0	3.0	14.0	6.0	4.0	6.0	2.0	6.0	0.5		47.5	4.8	0.5
[illegible]															
Simuliidae															
Ceratopogonidae															
Hydracarina															
Mollusca															
[illegible]															
[illegible]											1.0		1.0	0.1	T
[illegible]		[illegible]	822.0	266.0	299.3	1258.3	1895.3	220.3	2518.3	1994.0	173.2		10336.1		

*T = trace.

[1]No data collected at station 11.

Table 32

Mean number of macroinvertebrates (organisms/ft^2 = organisms/0.093 m^2) collected from plate samples taken at stations 1-11 in West Point Lake 3 January 1980.

Organism	Station 1	2	3	4	5	6	7	8	9	10	11	Total	$\bar{x}$	s
Nematoda														
Oligochaeta										0.5		0.5	T*	T
Naididae														
Tubificidae	0.3		0.5	1.0	0.3	3.0	0.3		0.5	11.0	4.0	20.9	1.9	1.3
Hirudinea						2.0		0.3	0.3			2.6	0.2	0.2
Cladocera														
Copepoda	172.0	88.0	127.0	158.0	101.0	409.0	127.0	185.0	106.0	6.0	9.0	1488.0	135.3	95.7
Collembola			0.5					0.3				0.8	0.1	T
Entomobryidae														
Ephemeroptera														
Caenidae														
Caenis														
Ephemerellidae														
Ephemerella														
Heptageniidae														
Stenonema														
Leptophlebiidae														
Leptophlebia														
Siphlonuridae														
Isonychia														
Tricorythidae														
Tricorythodes														
Unidentified														
Odonata														
Coenagrionidae														
Argia														
Coleoptera														
Elmidae														
Diptera														
Ceratopogonidae														
Bezzia														
Chironomidae														
[illegible]														
[illegible]														
Hydroptilidae														
Hydroptila														
Orthotrichia														
Philopotamidae														
Chimarra														
Polycentropodidae														
Cyrnellus														
Neureclipsis														
Unidentified														
Trichoptera pupae	0.3											0.3	T	T
Trichoptera adult														

Table 32. Continued.

Organism	Station 1	2	3	4	5	6	7	8	9	10	11	Total	$\bar{x}$	%
Diptera														
Chironomidae														
Tanypodinae														
Ablabesmyia														
A. annulata														
A. mallochi									0.3			0.3	T	T
A. ornata														
A. parajanta														
A. tarella														
Clinotanypus														
Coelotanypus														
C. concinnus														
C. scapularis														
C. spp.														
Procladius														
Chironominae											0.5	0.5	T	T
Chironomini														
Chironomus						1.0						1.0	0.1	T
Cryptochironomus			0.3	0.3				0.3				0.9	0.1	1
C. [illegible]														
C. fulvus														
C. spp.														
Cryptotendipes														
Dicrotendipes	0.3					0.5		0.3		1.0	0.3	2.4	0.2	0.2
D. [illegible]														
[illegible]														
[illegible]														
E. nigricans						2.0						2.0	0.2	0.1
E. spp.														
Glyptotendipes	1.0	2.0		2.0	0.5	0.5		1.0	1.0	0.3		8.3	0.8	0.5
Harnischia											0.3	0.3	1	0.8
[illegible]														
[illegible]														
[illegible]									0.3			0.3	T	0.8
[illegible]														
[illegible]														
[illegible]														
[illegible]														
[illegible]														
[illegible]														
[illegible]														
[illegible]														
[illegible]														

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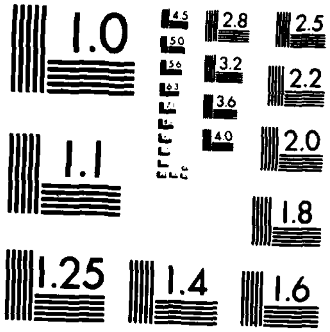

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Table 32. Continued.

Organism	Station 1	2	3	4	5	6	7	8	9	10	11	Total	$\bar{x}$	%
Chironominae, cont'd.														
Tanytarsini														
Cladotanytarsus														
Micropsectra									0.3			0.3	T	T
Rheotanytarsus														
Tanytarsus									2.0			2.0	0.2	0.1
Orthocladiinae	0.5											0.5	T	T
Brillia														
Corynoneura														
Cricotopus														
C. bicinctus										1.0		1.0	0.1	T
C. sp. T														
Eukiefferiella cerulescens					0.3							0.3	T	T
Psectrocladius														
P. vernalis														
P. sp.	0.3				0.5				2.0	14.0	2.0	18.8	1.7	1.2
Rheocricotopus														
Thienemanniella														
Unidentified														
Chironomid pupae	0.3											0.3	T	T
Chironomid adult						0.3				0.3		0.6	T	T
Empididae														
Simuliidae														
Ceratopogonidae	0.3											0.3	T	T
Hydracarina														
Mollusca														
Gastropoda														
Pelecypoda				0.3					0.3			0.6	T	T
TOTAL	175.3	90.0	128.3	161.6	102.6	418.3	127.3	187.2	113.0	34.1	16.1	1553.8		

*T = trace.

Table 33

Mean number of macroinvertebrates (organisms/ft^2 = organisms/0.093 m^2) collected from plate samples taken at stations 1-11 in West Point Lake 16 April 1980.

Organism / Station	1	2	3*	4	5*	6	7	8	9	10	11	Total	$\bar{x}$	%
Nematoda						0.5						0.5	T*	0.2
Oligochaeta														
Naididae	3.0	1.0		2.0		5.0	13.0	3.0	2.0	8.0	5.0	42.0	4.7	13.9
Tubificidae														
Hirudinea														
Cladocera	1.0	1.0		0.5		3.0		3.0	2.0			10.5	1.2	3.5
Copepoda	0.3									0.3		0.6	T	0.2
Collembola														
Entomobryidae														
Ephemeroptera														
Caenidae														
Caenis						0.3						0.3	T	0.1
Ephemerellidae														
Ephemerella										0.3		0.3	T	0.1
Heptageniidae														
Stenonema														
Leptophlebiidae														
Leptophlebia														
Siphlonuridae														
Isonychia														
Tricorythidae														
Tricorythodes														
Unidentified														
Odonata														
Coenagrionidae														
Argia						0.5						0.5	T	0.2
Coleoptera														
Elmidae														
Trichoptera														
Leptoceridae														
Oecetis														
Hydropsychidae														
Hydropsyche														
Macronema														
Hydroptilidae														
Hydroptila														
Orthotrichia						0.3						0.3	T	0.1
Philopotamidae														
Chimarra														
Polycentropidae														
Cyrnellus						2.0			0.5			2.5	0.3	0.8
Neureclipsis														
Unidentified														
Trichopteran pupae														
Trichopteran adult														

Table 33. Continued.

Organism	Station	1	2	3	4	5	6	7	8	9	10	11	Total	$\bar{x}$	%
Diptera															
Chironomidae															
Tanypodinae															
Ablabesmyia															
A. annulata															
A. mallochi							3.0		1.0	3.0			7.0	0.8	2.3
A. ornata															
A. parajanta					0.5		3.0			4.0			7.5	0.8	2.5
A. tarella															
Clinotanypus															
Coelotanypus															
C. concinnus															
C. scapularis															
C. spp.															
Procladius															
Chironominae															
Chironomini															
Chironomus															
Cryptochironomus		0.3											0.3	T	0.1
C. blarina															
C. fulvus															
C. spp.															
Cryptotendipes															
Dicrotendipes		0.3											0.3	T	0.1
D. lobus			0.3					2.0			0.8		3.1	0.3	1.0
D. nervosus			0.3				1.0		1.0				2.3	0.3	0.8
Endochironomus															
E. nigricans															
E. spp.															
Glyptotendipes		7.0	8.0		12.0		29.0	3.0	5.0	37.0	0.3		101.3	11.3	33.7
Harnischia															
Nilothauma															
Parachironomus															
P. carinatus															
P. directus					0.8		4.0			2.0		0.5	7.3	0.8	2.4
P. monochromus															
P. pectinatellae															
Paracladopelma															
Polypedilum															
P. convictum															
P. halterale															
P. illinoense								1.0			0.3		1.3	0.1	0.4
P. spp.															
Pseudochironomus											0.5		0.5	T	0.2
Tribelos															
Xenochironomus															

Table 33. Continued.

Group	Station 1	2	3	4	5	6	7	8	9	10	11	Total	$\bar{x}$	%
Chironominae, cont'd.														
Tanytarsini														
Cladotanytarsus														
Micropsectra														
Rheotanytarsus														
Tanytarsus	0.3	0.3										0.6	T	0.2
Orthocladiinae							1.0					1.0	0.1	0.4
Brillia														
Corynoneura														
Cricotopus														
C. bicinctus	0.3									5.0	1.0	6.3	0.6	2.1
C. sp. I		0.3				1.0	1.0					2.3	0.2	0.8
Eukiefferiella cerulescens														
Psectrocladius	0.3	0.5		1.0		2.0	12.0	44.0	2.0	16.0	5.0	82.8	7.5	27.5
P. vernalis														
P. sp.														
Rheocricotopus	0.3											0.3	T	0.1
Thienemanniella														
Unidentified														
Chironomid pupae	0.5	0.3		1.0		3.0	2.0	1.0	6.0	2.0		15.8	1.4	5.2
Chironomid adult		0.3		0.3		0.3		0.3	0.5			1.7	0.1	0.6
Empididae														
Simuliidae														
Ceratopogonidae											0.3	0.3	T	0.1
Hydracarina				0.3					0.5			0.8	T	0.3
Mollusca														
Gastropoda														
Pelecypoda														
TOTAL	13.6	12.3		18.4		57.9	35.0	58.3	59.5	33.5	11.8	300.3		

*T = trace.

Table 34

Mean number of macroinvertebrates (organisms/ft^2 = organisms/0.093 m^2) collected from plate samples taken at stations 1-11 in West Point Lake 1 July 1980.

Organism / Station	1	2	3	4	5	6	7	8	9	10	11	Total	$\bar{x}$	%
Nematoda	0.3	0.3	1.0					0.3	3.0			4.9	0.4	0.1
Oligochaeta														
Naididae	2.0	5.0	2.0			15.0			0.8		0.3	25.1	2.3	0.7
Tubificidae														
Hirudinea											0.5	0.5	T*	T
Cladocera	140.0	336.0	77.0	4.0	0.5	29.0		394.0	43.0	138.0	544.0	1705.5	155.0	50.4
Copepoda									0.3			0.3	T	T
Collembola														
Entomobryidae														
Ephemeroptera														
Caenidae														
Caenis			0.3					0.3	1.0		0.3	1.9	0.2	T
Ephemerellidae														
Ephemerella														
Heptageniidae														
Stenonema														
Leptophlebiidae														
Leptophlebia														
Siphlonuridae														
Isonychia														
Tricorythidae														
Tricorythodes														
Unidentified														
Odonata														
Coenagrionidae														
Argia							0.3		0.3			0.6	T	T
Coleoptera														
Elmidae														
Trichoptera														
Leptoceridae														
Oecetis									0.3			0.3	T	T
Hydropsychidae														
Hydropsyche														
Macronema														
Hydroptilidae														
Hydroptila														
Orthotrichia									0.3			0.3	T	T
Philopotamidae														
Chimarra														
Polycentropidae														
Cyrnellus	95.0	30.0	94.0	127.0	95.0	45.0	164.0	4.0	10.0	73.0	9.0	746.0	67.8	22.0
Neureclipsis														
Unidentified														
Trichopteran pupae	1.0	0.5					0.3	2.0	0.3	2.0	0.5	6.6	0.6	0.2
Trichopteran adult														

Table 34. Continued.

Organism / Station	1	2	3	4	5	6	7	8	9	10	11	Total	$\bar{x}$	%
Diptera														
Chironomidae														
Tanypodinae														
Ablabesmyia							2.0					2.0	0.2	0.2
A. annulata														
A. mallochi	2.0	7.0	1.0	2.0	3.0	5.0		42.0	9.0	14.0	5.0	90.0	8.2	2.7
A. ornata														
A. parajanta	1.0	2.0			0.8	0.3		7.0	3.0	4.0	7.0	25.1	2.3	0.7
A. tarella														
Clinotanypus														
Coelotanypus														
C. concinnus														
C. scapularis														
C. spp.														
Procladius														
Chironominae														
Chironomini														
Chironomus														
Cryptochironomus														
C. blarina														
C. fulvus														
C. spp.														
Cryptotendipes														
Dicrotendipes														
D. lobus	17.0	12.0	18.0	12.0	6.0		13.0	21.0	8.0	20.0	6.0	133.0	12.0	3.9
D. nervosus	26.0	26.0	53.0	21.0	6.0	1.0	17.0	44.0	4.0	14.0	16.0	228.0	20.7	6.7
Endochironomus														
E. nigricans									5.0	2.0	3.0	10.0	0.9	0.3
E. spp.														
Glyptotendipes	8.0	12.0	3.0	2.0	3.0	2.0	5.0	68.0	32.0	97.0	57.0	289.0	26.3	8.5
Harnischia														
Nilothauma									2.0			2.0	0.2	0.2
Parachironomus														
P. carinatus			2.0									2.0	0.2	0.2
P. directus	4.0	4.0		2.0	0.8		3.0					13.8	1.3	1.6
P. monochromus	2.0											2.0	0.2	0.2
P. pectinatellae			2.0									2.0	0.2	0.2
Paracladopelma														
Polypedilum														
P. convictum														
P. halterale														
P. illinoense								3.0				3.0	0.3	0.4
P. spp.														
Pseudochironomus														
Tribelos						1.0		3.0				4.0	0.4	0.5
Xenochironomus														

Table 34. Continued.

Organism	Station 1	2	3	4	5	6	7	8	9	10	11	Total	$\bar{x}$	%
Chironominae, cont'd.														
Tanytarsini														
Cladotanytarsus														
Micropsectra								4.0				4.0	0.4	0.1
Rheotanytarsus						1.0						1.0	0.1	0.1
Tanytarsus														
Orthocladiinae									3.0			3.0	0.3	0.1
Brillia														
Corynoneura														
Cricotopus														
C. bicinctus														
C. sp. T						2.0						2.0	0.2	T
Eukiefferiella cerulescens										1.0		1.0	0.1	T
Psectrocladius														
P. vernalis	4.0	2.0	2.0	3.0	0.5	1.0	2.0	3.0			2.0	19.5	1.8	0.6
P. sp.														
Rheocricotopus														
Thienemanniella														
Unidentified														
Chironomid pupae							2.0				3.0	5.0	0.5	0.1
Chironomid adult	3.0	4.0	7.0	2.0	0.8	1.0	0.8	6.0	2.0	2.0	3.0	31.6	2.9	0.9
Empididae	0.3		0.5			0.3		2.0				3.1	0.3	0.1
Simuliidae														
Ceratopogonidae														
Hydracarina														
Mollusca						11.0						11.0	1.0	0.3
Gastropoda														
Pelecypoda								3.0	0.8	0.8		4.6	0.4	0.1
TOTAL	305.6	440.8	262.8	175.0	116.4	114.6	209.4	606.6	128.1	367.8	656.6	3383.7		

*T = trace.

Table 35

Percent composition of the major groups of organisms collected from plate samples from February 1979 to July 1980.

Taxon	Feb 1979	Jan 1980	Apr 1979	Apr 1980	June 1979	July 1980	Oct 1979
Nematoda	1.6	T[1]	6.7	0.2	0.2	0.1	T
Oligochaeta	19.0	1.5	0.0	13.9	7.2	0.7	T
Cladocera	56.0	95.7	71.2	3.5	0.3	50.4	84.3
Copepoda	0.0	T	0.0	0.2	T	T	0.0
Ephemeroptera	0.2	0.0	0.0	0.2	0.0	T	T
Trichoptera	0.0	T	0.6	0.9	5.3	22.2	2.2
Chironomidae	22.0	2.5	21.5	79.9	85.4	25.8	13.4
Ceratopogonidae	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Gastropoda	0.0	0.0	0.0	0.0	0.7	0.0	0.0

[1]Denotes trace (< 0.1)

Table 36

Percent composition of the major taxa of the family Chironomidae collected from plate samples from February 1979 to July 1980.

Taxon	Feb 1979	Jan 1980	Apr 1979	Apr 1980	June 1979	July 1980	Oct 1979
Ablabesmyia	0.0	0.8	1.8	6.5	4.1	10.7	0.6
Chironominae	0.0	1.3	0.0	0.0	11.9	0.0	0.0
Dicrotendipes	5.5	6.1	51.9	2.5	16.7	42.9	42.6
Glyptotendipes	4.0	21.2	31.6	45.2	59.2	34.3	49.4
Rheotanytarsus	14.4	5.1	2.7	0.0	0.0	0.0	0.2
Cricotopus	57.5	2.6	0.2	0.0	0.2	0.0	0.5
Psectrocladius	4.2	48.0	0.5	37.0	1.1	2.3	0.7
Total percentage of composition	85.6	85.1	88.7	91.2	93.2	90.2	94.0

Table 37

Mean density, number of taxa, diversity ($\bar{d}$) and equitability (e) of macroinvertebrates collected on plate samplers for each sampling period during 1978-79 and 1979-80.

Station	Month	Organisms/ft^2		Taxa		$\bar{d}$		e	
		(Year)78-79	79-80	78-79	79-80	78-79	79-80	78-79	79-80
1	O	--[1]	890.4	--	18	--	2.22	--	0.33
	J-F	168.8	176.7	3	10	1.48	0.25	1.08	0.10
	A	1034.0	13.6	5	11	0.87	2.28	0.61	0.64
	J	235.0	305.6	11	15	2.04	2.16	0.50	0.40
2	O	--	822.0	--	11	--	1.51	--	0.36
	J-F	81.0	90.0	2	2	0.80	0.15	1.17	0.50
	A	1947.0	12.3	5	10	0.64	1.96	0.43	0.50
	J	98.2	440.8	8	13	2.04	1.47	0.75	0.23
3	O	--	266.0	--	7	--	1.44	--	0.43
	J-F	148.5	128.3	3	4	1.31	0.10	1.00	0.25
	A	372.5	--	4	--	0.78	--	0.71	--
	J	93.0	262.8	10	14	2.44	2.30	0.79	0.50
4	O	--	298.3	--	9	--	2.04	--	0.56
	J-F	256.5	161.6	3	5	0.84	0.19	0.94	0.20
	A	2327.2	18.4	8	9	1.04	1.88	0.33	0.56
	J	193.5	175.0	8	9	2.06	1.49	0.78	0.33
5	O	--	1258.3	--	7	--	0.83	--	0.29
	J-F	81.0	102.6	2	5	0.61	0.15	0.83	0.20
	A	1827.0	--	4	--	0.34	--	0.25	--
	J	85.0	116.4	10	10	2.41	1.17	0.75	0.30
6	O	--	1895.3	--	10	--	0.39	--	0.10
	J-F	1525.5	418.3	3	8	0.34	0.21	0.50	0.13
	A	2964.8	57.9	2	16	0.31	2.73	0.61	0.56
	J	204.0	114.6	6	14	2.17	2.48	1.25	0.57
7	O	--	220.3	--	12	--	2.02	--	0.42
	J-F	195.8	127.3	2	2	0.53	0.24	0.88	0.50
	A	450.0	35.0	4	8	0.71	2.28	0.67	0.87
	J	333.5	209.4	6	11	1.96	1.28	0.84	0.27
8	O	--	2518.3	--	10	--	0.39	--	0.10
	J-F	148.5	187.2	2	6	0.77	0.12	1.00	0.17
	A	2236.0	58.3	8	8	1.50	1.39	0.50	0.37
	J	981.0	606.6	7	17	1.62	1.92	0.61	0.29
9	O	--	1994.0	--	9	--	0.41	--	0.22
	J-F	900.0	113.0	2	10	0.69	0.50	[illegible]	[illegible]
	A	4992.5	59.5	8	11	1.59	2.07	0.55	0.55
	J	697.5	128.1	8	20	1.53	2.99	0.54	0.55
10	O	--	173.2	--	14	--	0.77	--	0.14
	J-F	689.0	34.1	6	8	1.98	2.00	0.38	0.63
	A	298.0	33.5	4	10	1.34	2.12	0.57	0.60
	J	955.2	367.8	8	12	1.76	2.32	0.65	0.58
11	O	--	--	--	--	--	--	--	--
	J-F	167.0	16.1	3	6	1.29	1.71	1.14	0.67
	A	98.0	11.8	3	5	0.99	1.68	1.00	0.40
	J	--	656.6	--	15	--	1.09	--	0.13
$\bar{x}$		837.0	380.0	5	10	1.26	1.33	[illegible]	[illegible]

[1] Dash (--) indicates no data at that station on that date. Months: O, October; J-F, January-February; A, April; J, July.

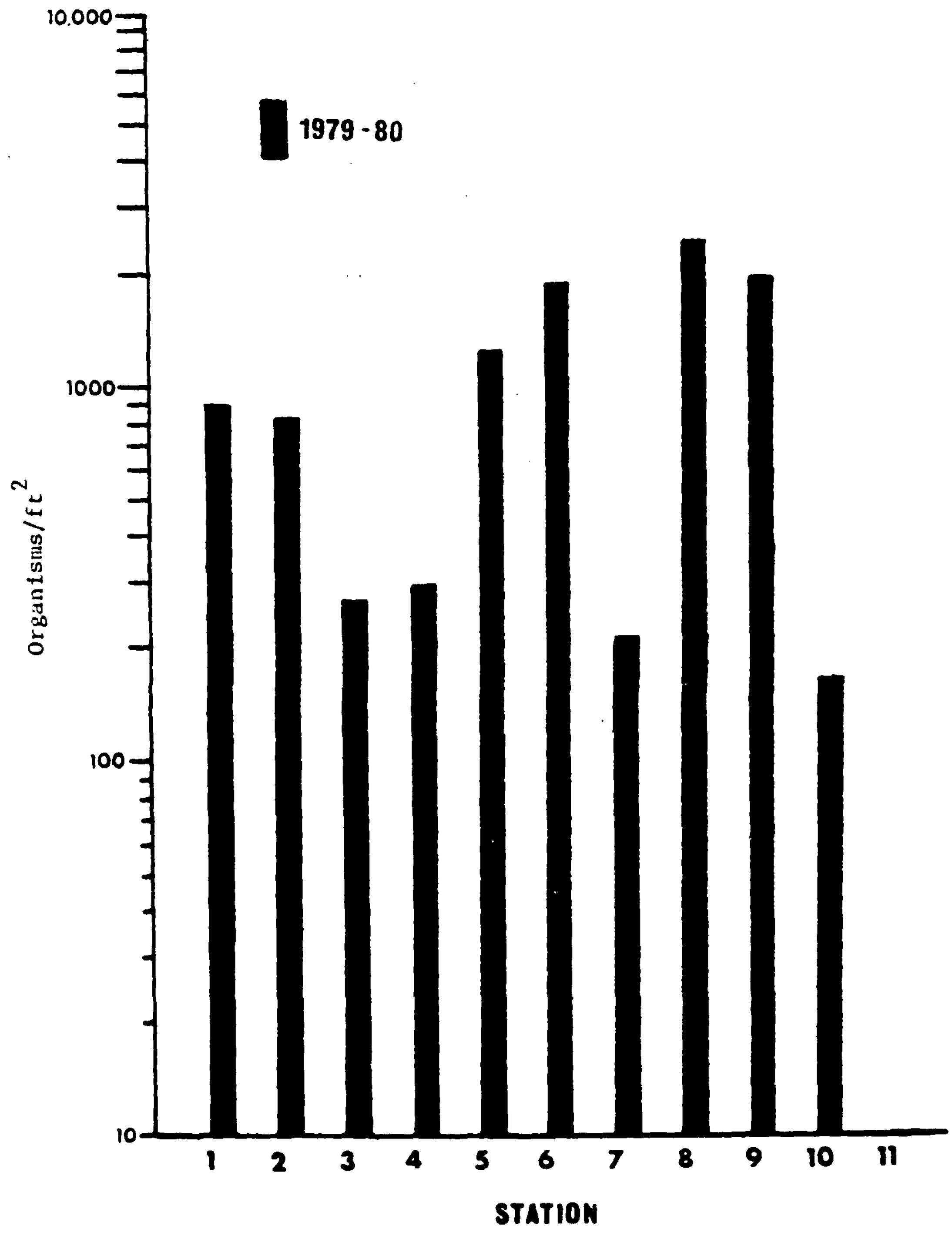

Figure 14. Mean number of macroinvertebrates (organism/ft^2 = organisms/0.093 m^2) from plate samplers taken at each station in West Point Lake for October 1979. No comparable samples were collected in October 1978. No samplers were found at station 11.

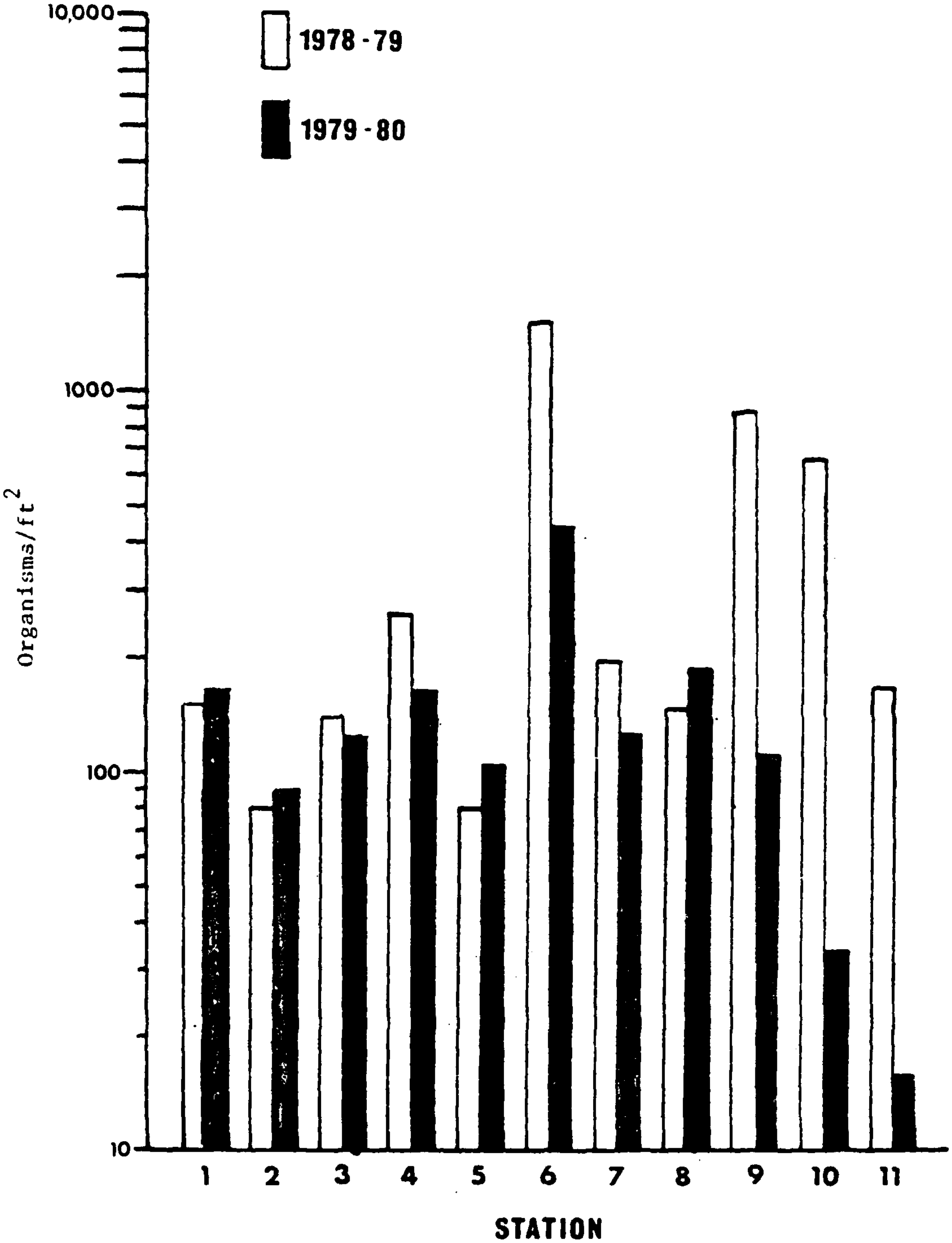

Figure 15. Mean number of macroinvertebrates (organisms/ft^2 = organisms/ 0.093 m^2) from plate samplers taken at each station in West Point Lake for the winter 1978-79 and 1979-80 sampling periods.

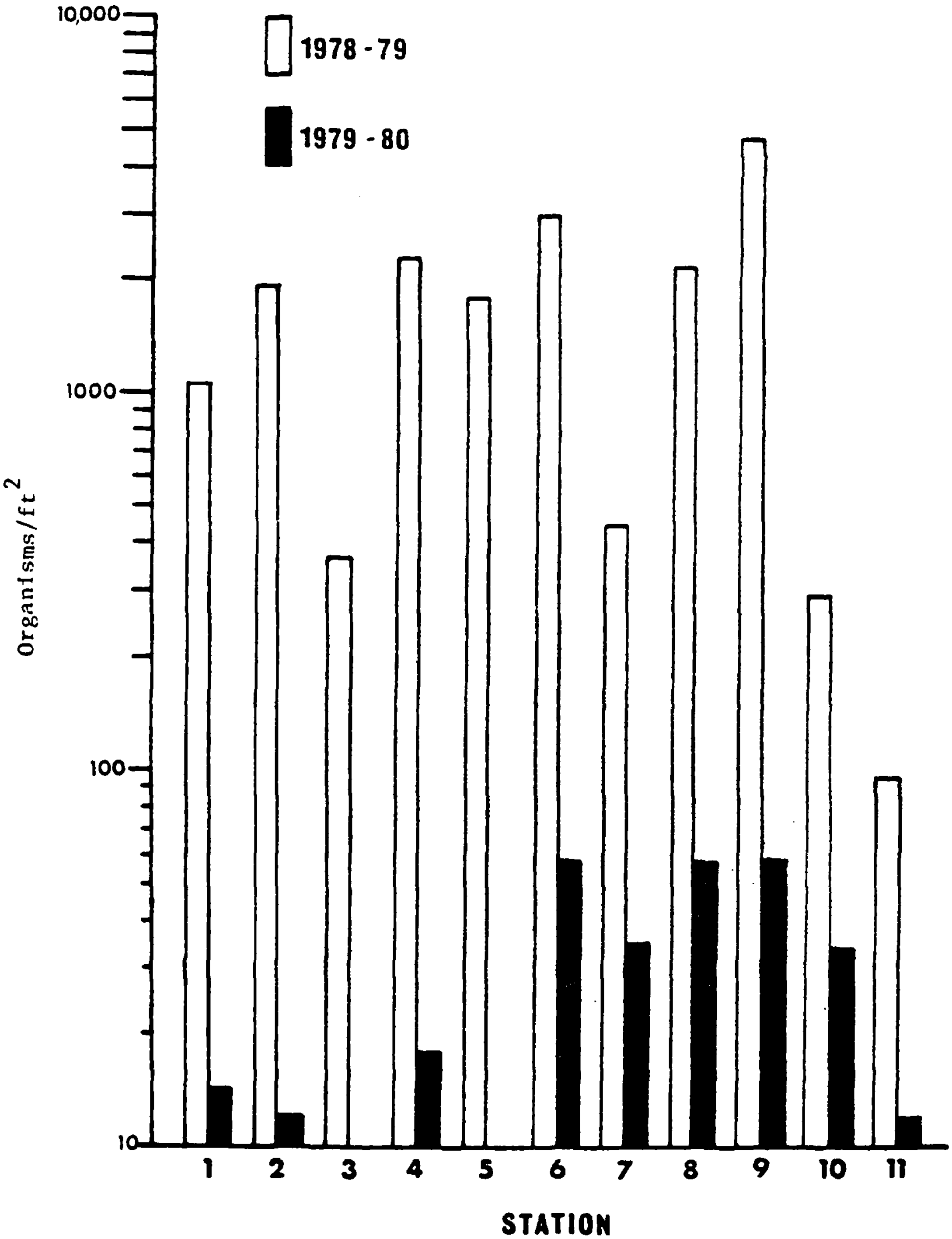

Figure 16. Mean number of macroinvertebrates (organisms/ft^2 = organisms/ 0.093 m^2) from plate samplers taken at each station in West Point Lake for the spring 1978-79 and 1979-80 sampling periods.

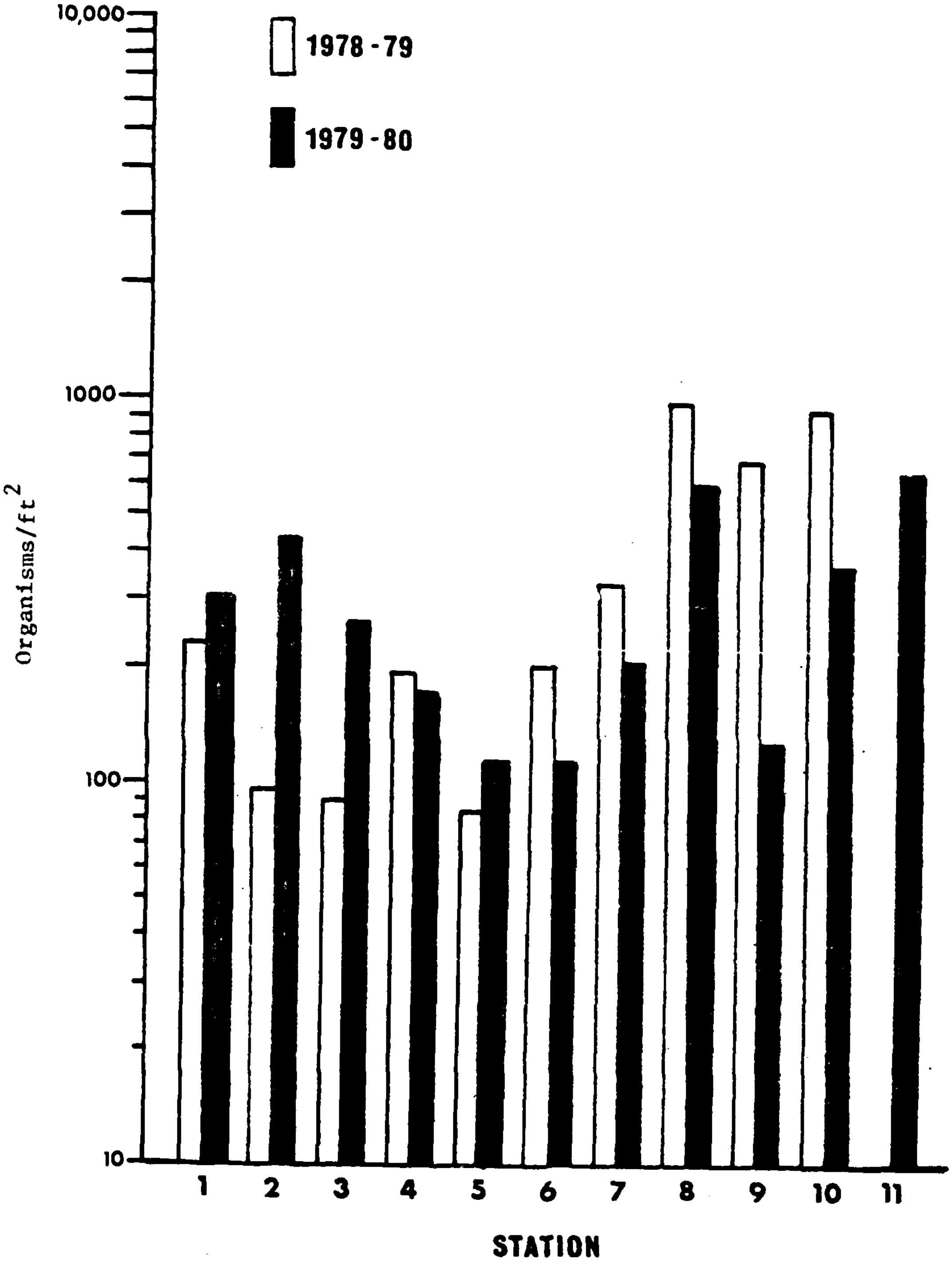

Figure 17. Mean number of macroinvertebrates (organisms/ft^2 = organisms/ 0.093 m^2) from plate samplers taken at each station in West Point Lake for the summer 1978-79 and 1979-80 sampling periods.

83. During 1979-80 macroinvertebrate density on plate samplers was significantly less ($P < 0.05$) than that from 1978-79. The April sample collected in 1980 was unusually low at all stations (Table 37 and Figure 16). However, the plate samplers at station 3 and 5 were lost. The total number of organisms for April 1980 was less than two percent of the total for April 1979.

Macroinvertebrate Diversity and Equitability

84. Annual mean diversity calculated from the dredge samples ranged from 0.97 at station 12 in the headwaters to 3.2 at station 2 at the dam. Annual mean diversity calculated from the plate samplers ranged from 0.72 at station 5 in the Wehadkee Creek arm of the reservoir to 1.8 at station 10 in the upper third of the reservoir. Diversity from plate samplers averaged less than diversity from the dredge samples (Tables 30 and 37).

85. The average number of taxa identified from dredge samples ranged from a low of 6 at station 12 to a high of 18 at station 3. The average number of taxa identified from plate samplers ranged from a low of 7 at station 5 to a high of 14 at station 3 (Tables 30 and 37).

Limnological Discussion

Plankton

Phytoplankton/Chlorophyll Relationships

86. Phytoplankton standing crop expressed as number of organisms/ml had a yearly mean of 1,585, much lower than similar means from previous years (Davies et al. 1979; Bayne et al. 1980). This decline in abundance of phytoplankton resulted from fewer numbers of yellow-green algae (Chrysophyta) collected during 1979-80 compared with previous years. Annual mean standing crops for 1976-77, 1977-78, 1978-79 and 1979-80 were 3,272, 2,222, 2,229 and 1,585, respectively. The decline in yellow-green algae collected this year was also reflected in lower chlorophyll *c* standing crops at all stations (Table 8).

87. The upper, lotic reaches of the reservoir at station A had the lowest phytoplankton density while the more lentic reaches at stations B, C, D, F and G had much higher standing crops of phytoplankton (Table 4). Lentic areas of the reservoir have less unidirectional movement of water (reduced flow) than lotic areas, plus lower turbidity as suspended sediment settles toward the bottom. Reduced flow coupled with decreased turbidity in the photic zone allows for increased phytoplankton abundance in the lentic areas of the lake.

88. Chlorophyll a values for the year were also lowest at station A and highest at stations B, C, D, F and G (Tables 7 and 8). The fact that chlorophyll a concentrations for the year at stations B and C resembled values at station D reflected the increased numbers of green algae (Chlorophyta) collected in those samples (Table 7). The October phytoplankton sample at station G in Yellowjacket Creek had unusually high chlorophyll a concentrations because of the presence of large numbers of yellow-green and green algae (Tables 3 and 7).

89. Phytoplankton abundance and chlorophyll a concentrations during 1979-80 exhibited a significant positive correlation ($r = 0.59$; $P < 0.0001$). This correlation was expected since a close relationship usually exists between the concentration of chlorophyll a in water and the total abundance of phytoplankton (Boyd 1979). It is noteworthy that the correlation between these two variables was not significant when calculated for samples collected only during warm weather months (summer and fall). In previous years this correlation has been stronger for the warm weather months than the year as a whole (Davies et al. 1979; Bayne et al. 1980). The difference in 1979-80 may have resulted from the fact that only one phytoplankton sample was collected during the warm weather period, in August. Usually, warm weather samples are collected in June and September.

90. Phytoplankton density and turbidity values for the year exhibited a significant negative correlation ($r = -0.61$; $P < 0.0001$) as did chlorophyll a concentration and turbidity ($r = -0.57$; $P < 0.0001$). These two negative correlations indicate the importance of reduced light penetration in the photic zone and photosynthetic activity of the algae. Increasing turbidity reduces phytoplankton and chlorophyll standing crops.

91. Documenting all of the environmental factors that contribute to dense phytoplankton blooms remains a difficult task. The factors in West Point Lake previously reported to have significant impact in producing "blooms" were high water temperatures, reduced water flow through the reservoir, low turbidities and high solar radiation (Shelton et al. 1981). The three dates (October, May and August) with the highest mean phytoplankton densities had favorable environmental conditions at stations exhibiting significant numbers of algae. Temperatures on these three dates averaged about 18 C to 29 C (Appendix A, Table 3). Mean daily inflows for the reservoir were relatively low, ranging from 2,972 to 3,495 cfs (Appendix A, Table 1). Solar radiation was relatively high ranging from 9,541 Langleys in October to 14,594 Langleys in August (Appendix A, Table 1). Turbidity in the photic zone at most stations in October, May and August was relatively low, averaging less than eight Jackson Turbidity Units (Appendix A, Table 2).

Primary Productivity

92. Primary productivity was highest during September as in previous studies except for 1978-79 (Shelton et al. 1981). Lowest

productivity was measured during December. Productivity each quarter was similar to that measured the previous year except for the summer. Mean productivity during June was 881 mg C/m^2/day while the previous year it was estimated at 1,612 mg C/m^2/day. This year's estimate was closer to June measurements from studies prior to 1978-79.

93. Primary productivity was significantly different ($P < 0.05$) between mainstream stations. Highest mean productivity of 896.1 mg C/m^2/day was measured at station B in the upper reaches of the reservoir. Station D near the dam was next highest at 631.3 mg C/m^2/day. Productivity in Wehadkee and Yellowjacket Creeks was not significantly different ($P > 0.05$), but this year's values were considerably lower than those measured the previous year (Shelton et al. 1981).

94. The spatial pattern of production shown in Figure 10 more closely resembles the 1977-78 year than 1978-79 (Bayne et al. 1980; Shelton et al. 1981). This year's mean productivity estimate for the reservoir of 559.4 mg C/m^2/day was the lowest measured to date. Estimates made during past years were 689, 744 and 707 mg C/m^2/day for 1976-77, 1977-78 and 1978-79, respectively. This decline was not statistically significant ($P > 0.05$) but it may represent a trend toward decreased productivity with aging of the reservoir.

Organic Matter and Carbon

95. Suspended organic matter (SOM) analyses provide only approximations of the amount of organic matter present in the water. They are not used as an accurate measure of organic carbon. However, SOM measurements were useful in pointing out that the upper reaches of the lake at stations A and B had higher concentrations of suspended organic matter than middle and lower reaches (Table 14). This type of allochthonous organic loading of lotic areas in a reservoir are common (Wetzel 1975). Analyses of SOM from previous research found the same results (Davies et al. 1979; Bayne et al. 1980 and Shelton et al. 1981). As the suspended organic load enters the reservoir with the Chattahoochee River some of the suspended material settles to the bottom as the water moves downstream.

96. Mean total organic carbon (TOC) concentrations measured at all stations varied little on a given date and only slightly more between dates (Table 16). Data in Table 16 illustrate the fact that there is usually little difference in the amounts of organic carbon entering or leaving the reservoir. Since TOC includes dissolved and particulate carbon and values leaving the reservoir differ little from that entering, apparently the plankton community contributes significantly to the organic carbon in the water. There was a significant positive correlation between TOC and phytoplankton density ($r = 0.61$; $P < 0.0001$), also between TOC and chlorophyll *a* concentrations ($r = 0.52$; $P < 0.0001$). Highest TOC values were in September and August reflecting high phytoplankton standing crops during these periods. Mean TOC

concentrations for 1976-77, 1977-78, 1978-79 and 1979-80 were 6.0, 6.4, 5.8 and 5.1 mg/l, respectively (Davies et al. 1979; Bayne et al. 1980 and Shelton et al. 1981). This decline in mean TOC may represent additional evidence of a gradual decrease in productivity of the lake.

Zooplankton

97. Zooplankton Abundance. Spatial and seasonal distributions of zooplankton within the lake were similar to patterns observed in previous years except for August (Davies et al. 1979; Bayne et al. 1980 and Shelton et al. 1981). This pattern has generally consisted of higher densities during warmer months and lower densities in winter. Zooplankton density in August was unusually low because of a decline in the number of rotifers collected (Table 19). This decrease in density occurred throughout the reservoir and probably reflects a low point in the periodic fluctuations typical of rotifer populations. There is no evidence from the August samples that predation by copepods or other invertebrates might have significantly reduced rotifer density (Appendix A, Table 5).

98. Zooplankton Dominance. Limnetic (pelagic) zooplankton communities in West Point Lake were again dominated by rotifers. The other two important groups comprising zooplankton samples were copepods and cladocerans. In general, limnetic samples in lakes usually contain one species of rotifer, one copepod, and one cladoceran which are exceptionally abundant and clearly dominant numerically over other species in those groups (Pennak 1978). For the West Point samples, one of three species of rotifers (*Keratella cochlearis*, *Conochilus unicornis*, or *Trichocerca cylindrica*) were dominant on most dates. In the copepod group, immature nauplii dominated on every date along with an unidentified species of cyclopoid and/or calanoid copepod. In the cladoceran group, *Bosmina longirostris* dominated on most dates (Tables 20 and 21).

99. The low standing crops of zooplankton in August reflected the same pattern of dominance as that from other dates. Rotifers dominated numerically, followed in order by the copepods and cladocerans (Appendix A, Table 5). The most likely explanation for the continued dominance of rotifers in the zooplankton community of West Point Lake was predation effects (by both fish and invertebrates) on copepods and cladocerans.

100. Zooplankton Diversity and Equitability. The community structure of zooplankton populations change so rapidly that sampling represents only a momentary assessment of the species present. Limnetic communities are also characterized by a relatively few species dominating the samples. This fact tends to reduce the calculated diversity ($\bar{d}$) of the samples but not because of some type of pollution. Based on similar data from previous investigations in West Point Lake the density, number of taxa, diversity ($\bar{d}$), and equitability of zooplankton samples collected during 1979-80 showed no important differences from previous years (Table 22).

Benthic Macroinvertebrates

Community Structure

101. The benthic macroinvertebrate fauna of the reservoir was dominated by aquatic earthworms (Oligochaeta), water fleas (Cladocera) and midges (Chironomidae). Other groups that comprised from 1-22% of the macroinvertebrate community, depending on the season and type sample, were nematodes (Nematoda), copepods (Copepoda), mayflies (Ephemeroptera), caddisflies (Trichoptera), phantom midges (Chaoboridae), biting midges (Ceratopogonidae), and mollusks (Gastropoda and Pelecypoda).

102. Community structure of the macroinvertebrate fauna varied somewhat between the bottom (dredge) samples and the plate samples since the two methods sample different habitats. On most dates bottom samples were dominated by oligochaetes and chironomids while plate samples were dominated by cladocerans and chironomids.

103. Dredge and plate samples were collected in littoral (shoreline) and sublittoral zones of the lake. However in a reservoir like West Point, shoreline areas have little, if any, aquatic vegetation because of significant water level fluctuations. Therefore, the demarcation between littoral, sublittoral and deeper profundal zones is not as sharp.

104. The benthic fauna in profundal zones is usually dominated by two groups of invertebrates, chironomids and oligochaetes (Wetzel 1975). These two groups dominated dredge samples taken from the littoral areas in West Point Lake. The percentage composition of chironomids and oligochaetes found in the lake was similar to data presented by Wetzel (1975) for eutrophic lakes.

105. Another difference in macroinvertebrate collections was the percentage composition of the two oligochaete families from dredge and plate samples. Dredge samples consisted mostly of tubificids while plate samples were mostly naidids (Tables 28 and 35). Wetzel (1975) pointed out that oligochaete species are separated within the bottom sediments. Naidid oligochaetes concentrate at the sediment-water interface, seldom deeper than 2 to 4 cm below the surface. Tubificid oligochaetes are most dense between 2 to 4 cm of sediment depth. This might explain why the oligochaetes on plate samplers were mainly naidids since they would be more likely to swim up into the water column where the samplers were suspended.

106. One of the notable features of cladoceran zooplankton is their daily vertical migrations over large distances (Wetzel 1975). This may explain the large number of cladocera collected on the plate samplers (Table 35). Another interesting feature of plate collections was the ratio of cladocera to chironomidae. When one of these groups comprised more than 50% of the sample, the other group made up 25% or

less (Table 35). Since the cladocerans and chironomids that dominated the plate collections both feed on similar items, apparently competition for available food greatly influenced colonization by these invertebrates.

Trophic Relationships

107. The feeding relationships discussed here center on the principal invertebrate groups collected: oligochaetes, chironomids, and cladocerans. Understanding the food habits of these invertebrates also provides insight into the trophic status of the lake.

108. The majority of aquatic oligochaetes feed by ingesting substrate material, the organic component being digested as it passes through the gut (Pennak 1978). Under some circumstances the food may consist largely of filamentous algae, diatoms, or miscellaneous plant and animal detritus.

109. Cladocera filter food particles from the water by the use of their highly setose thoracic legs. Chief food items are algae, protozoa, organic detritus and bacteria (Pennak 1978). These types of food items comprised the periphytic community on the plate samplers so it was not surprising that cladocerans were so numerous in most of these collections (Table 35).

110. Trophic relationships of the chironomid fauna from dredge samples were more diverse than those from plate samples. Approximately half of the genera from the dredge samples were engulfers, predators on rotifers, microcrustacea or other chironomids. Merritt and Cummins (1978) classify the following genera (common in dredge samples) as predators: *Coelotanypus*, *Procladius*, *Cryptochironomus* and *Parachironomus*. Remaining chironomid genera were either collectors (gathers or filterers) or shredders (herbivores feeding on filamentous algae). The dominant herbivores comprising the chironomid fauna in dredge samples were *Tanytarsus*, *Glyptotendipes* and *Chironomus* (Table 29).

111. Plate samples were dominated by chironomid genera that were collectors and/or shredders. These genera feed either by gathering, filtering, shredding, or a combination of these methods (Merritt and Cummins 1978). Two genera dominated on most dates: *Glyptotendipes* and *Dicrotendipes*. However, on selected dates *Psectrocladius*, *Cricotopus* and *Rheotanytarsus* comprised the largest percentage of the chironomid fauna. The only predator collected was *Ablabesmyia* (Table 36).

Macroinvertebrate Density

112. The reduction in average density during April was partly due to loss of plate samplers and partly to environmental factors. Rainfall during March when the plates were being colonized totaled 13.87 inches (Appendix A, Table 1). The heavy rains resulted in excessive flow of water through the reservoir. This was reflected in the greater mean daily inflow and discharge during March and April. Compared with the previous year, water turbidity was higher and temperatures averaged 4 C lower for the same period (Shelton et al. 1981; Appendix A, Tables 2 and 3).

113. The environmental factors described above had a major impact on colonization of the plate samples. Much of this impact would have been on the growth of algae, protozoa and bacteria on the plates. In particular, decreased light penetration due to turbidity, lower temperatures and greater flow of water through the reservoir significantly reduced optimum conditions for development of the periphytic community that served as the food base for macroinvertebrates. Decreased light penetration reduced the amount of light available for photosynthetic algae; lower water temperatures may have slowed metabolic activity for periiphytic organisms; and greater flow-through of water reduced the opportunity for organisms to remove nutrients necessary for growth.

114. Wetzel (1975) indicated that even though mortality of benthic invertebrates can be very high from fish predation (up to half), food supply for the invertebrates generally is the dominant controlling factor influencing the population dynamics and productivity of benthic invertebrates.

115. Analyses of bluegill stomach contents collected during the spring of 1980 revealed that fish eggs (probably bluegill eggs) were the principal diet item (Din Ali, personal communication[1]). The bluegill were also considered in poor condition. These fish typically feed in the water column on benthic invertebrates like cladocera and chironomids. However, the lower standing crops of benthos in the littoral and sublittoral (out to a depth of approximately 7 m) zones apparently forced the bluegill to feed more on eggs.

Species Diversity

116. Another measure of the trophic status of the lake was made based on species diversity ($\bar{d}$) and equitability (e) values. The lake was classified as oligotrophic, mesotrophic or eutrophic instead of clean, intermediate and mildly polluted, or highly enriched. Patrick (1970) and Ransom and Dorris (1972) felt this substitution w-s

[1]Din Ali, Doctoral Student, Department of Fisheries and Allied Aquacultures, Auburn University, Alabama.

appropriate since clean waters are typically characterized by large numbers of benthic species with few individuals per species (also typical of oligotrophic waters). High d and e would be expected from benthic collections made in nonpolluted waters. Aquatic environments between the extremes of heavy pollution and clean water would be expected to have intermediate diversity values. Values of less than one have been obtained from heavily stressed waters; values from one to three from waters receiving moderate stress, and values larger than three from clean waters (Wilhm and Dorris 1968).

117. Based on the average species diversity ($\bar{d}$), the reservoir would be classified as mesotrophic. Yearly mean d values calculated from bottom grabs were between one and three except for station 12 (Table 30). Plate sampler collections typically had lower average d than the dredge samples (Table 37). Since plate samplers are a less variable substrate than the lake bottom the lower $\bar{d}$ from these collections was expected. Also, these samplers accumulate large numbers of cladocerans during certain seasons.

Fishery Results and Discussion

Postimpoundment Fish Population Changes

118. After six years of impoundment (1975-1980), the changes in the fish populations have been largely independent of what is popularly called the "New Land" effect of a recently impounded reservoir. Consequently, the expected pattern of an intially high standing stock of fishes that gradually declines to some equilibrium level has not emerged. There has been no verifiable change in the standing stock estimates during 1975-80. Trends in the fish community have been associated with a restructuring of the size and age composition of the relatively few dominant species and represents a summation of the dynamics of growth, reproduction and mortality.

Species Composition

119. The fish populations of the West Point Lake basin and postimpoundment changes were discussed in detail in the report for Phase I (1975-1977) (Davies et al. 1979), for Phase II (1977-1978) (Bayne et al. 1980), and for the Phase III (1978-1979) (Shelton et al. 1981). The present discussion will update the status and examine the former periods to indicate trends.

120. The total species list for West Point Lake to date includes 60 species (Appendix A, Table 6). However, the number of species collected from the reservoir has changed from year to year (Table 38). In general, there was an abrupt transition in the early postimpoundment period as those species not suited for reservoir conditions disappeared. The total number of species in the preimpoundment fish community was 53

Table 38

Checklist of Fish Species, West Point Lake, Alabama-Georgia, collected during pre- and postimpoundment periods.

	Pre	1975	1976	1977	1978	1979	1980
Petromyzontidae							
Southern Brook lamprey	X	X	-	-	-	-	-
Lepisosteidae							
Longnose gar	X	X	X	X	X	-	-
Amiidae							
Bowfin	X	X	X	X	X	X	X
Clupeidae							
Gizzard shad	X	X	X	X	X	X	X
Threadfin shad	-	X	X	X	X	X	X
Esocidae							
Redfin pickerel	X	X	-	X	X	X	X
Chain pickerel	X	X	X	X	-	-	X
Cyprinidae							
Stoneroller	X	X	-	-	-	-	-
Goldfish	-	X	X	X	X	-	X
Carp	-	X	X	X	X	X	X
Silverjaw minnow	X	X	-	-	-	-	-
Undescribed chub	X	X	X	-	-	-	-
Bluehead chub	X	-	-	-	-	-	-
Golden shiner	X	X	X	X	X	X	X
Blacktip shiner	X	X	X	X	-	-	-
Bluestripe shiner	X	X	X	X	-	-	-
Highscale shiner	X	-	-	-	-	-	-
Longnose shiner	X	X	X	-	X	X	-
Red shiner	X	X	X	X	-	-	-
Weed shiner	X	X	X	X	-	-	X
Blacktail shiner	X	X	X	X	X	X	-
Bandfin shiner	X	-	-	-	-	-	-
Fathead minnow	X	-	-	-	-	-	-
Creek chub	X	-	-	-	-	-	X
Catostomidae							
Quillback sucker	X	X	X	-	X	-	-
Creek chubsucker	X	X	X	X	X	X	X
Lake chubsucker	X	-	-	-	-	-	-
Alabama chubsucker	X	-	-	-	-	-	-
Spotted sucker	X	X	X	X	X	X	X
Greater jumprock	X	X	X	X	-	-	X
Undescribed redhorse	X	X	X	X	X	X	X

Ictaluridae							
Snail bullhead	X	X	X	X	X	X	X
White catfish	-	X	X	X	-	X	X
Black bullhead	X	X	X	X	-	X	X
Yellow bullhead	X	X	X	X	X	X	X
Brown bullhead	X	X	X	X	X	X	X
Channel catfish	X	X	X	X	X	X	X
Speckled madtom	X	-	-	-	-	-	-
Cyprinodontidae							
Southern studfish	X	-	-	-	-	-	-
Poeciliidae							
Mosquitofish	X	X	X	X	X	X	-
Atherinidae							
Brook silverside	X	X	X	X	X	X	X
Percichthyidae							
Striped bass x white bass	-	-	-	-	X	X	X
Centrarchidae							
Flier	X	X	X	X	X	X	X
Redbreast sunfish	X	X	X	X	X	X	X
Green sunfish	X	X	X	X	X	X	X
Warmouth	X	X	X	X	X	X	X
Bluegill	X	X	X	X	X	X	X
Dollar sunfish	-	X	X	X	X	X	-
Redear sunfish	X	X	X	X	X	X	X
Spotted sunfish	X	X	X	X	X	X	X
Redeye bass	X	-	-	-	-	-	-
Shoal bass	X	X	-	-	-	-	-
Spotted bass	X	X	X	X	X	X	X
Largemouth bass	X	X	X	X	X	X	X
Black crappie	X	X	X	X	X	X	X
Percidae							
Swamp darter	-	X	X	X	X	X	X
Yellow perch	X	X	X	X	X	X	X
Blackbanded darter	X	X	-	-	-	-	-
Walleye	-	X	-	-	-	-	-
Cottidae							
Banded sculpin	X	-	-	-	-	-	-
	53	48	41	40	35	32	34

species (Shelton and Davies 1977) but the number of species declined to 48 in 1975 and to 40 by 1977 (Timmons et al. 1978). The postimpoundment fauna includes six species that were not found in the stream community. The species composition has generally stabilized, with 35 species having been collected in 1978, 32 in 1979 and 34 in 1980 (Table 38).

121. In 1977, rotenone sampling of the littoral areas was initiated and several fish species that are not usually collected by electrofishing, gill netting, etc. were found to be more widespread and abundant than formerly believed. Even though these fish species were reproducing, few of them were recruited into the fishery. The redfin pickerel was abundant in the early years of impoundment but has declined. Young of this species continue to be collected but few adults are found. Loss of cover and the resulting increase in predation are probable factors. Cyprinids, in general, are more abundant from rotenone samples of fish populations in the littoral zone than when compared to cove rotenone sampling data. Evidently a greater variety of habitats are being sampled in the littoral zone.

Standing Stock

122. The total estimated standing stock of fish from cove rotenone sampling in 1980 ranged from a low of 177 kg/ha to a high of 616 kg/ha (Table 39). The coefficient of variation calculated from means of four cove samples each year continues to indicate greater variation between coves than between years. In this respect, coves designated as "reference" (Table 39) are sampled each year and tend to have somewhat greater consistency than those coves designated as "random." The relatively consistent between-year estimates indicate that any major increase or decrease in standing stock could be noted and verified statistically.

123. A relatively large number of species comprise the fish community. Many of these fish species have not maintained strong populations in the reservoir; however, those species that are suited for the lentic habitat have dominated the fish community.

124. The relative importance of each species has changed in the first six years of impoundment (Table 40). In 1975, seven species (bowfin, gizzard shad, carp, brown bullhead, bluegill, largemouth bass, and black crappie) had E values or percent of total standing stock (Swingle 1950) greater than 5%, and only two of these composed more than 10% of the standing stock. From 1976 to 1980 three to four of the same species had E values greater than 5%, and from one to three of the same species contributed greater than 10% to the biomass. Of interest is the apparent increasing abundance of white catfish in the reservoir. Infrequently collected during the first four years of impoundment, this species has increased to measurable levels in the last two years. Several of these important species will be discussed in detail in the following paragraphs.

Table 39

Standing stock estimates (kg/ha) for West Point Lake, Alabama-Georgia. Estimates are based on four large cove rotenone samples (0.5-1.7 ha) taken each year during July-August.

Year	Cove samples (group) Reference (I)	Random (II)	Random (III)	Reference (IV)	Means	C.V. (%)	Total area (ha)
1975	282.1	762.3	325.5	189.5	389.8	65.2	2.84
1976	264.9	785.2	253.7	150.4	363.5	78.6	2.93
1977	356.0	2,854.5	317.4	209.7	934.4	137.1	1.92
1978	284.4	236.1	386.6	232.6	284.9	25.2	3.87
1979	865.6	1,079.9	314.6	125.6	596.4	75.4	2.67
1980	233.9	616.5	252.8	177.1	320.1	62.5	2.64
Means	381.1	1,055.7	308.4	180.8	481.5		
C.V. (%)	63.2	87.4	16.3	21.5			

Major Species Biology and Dynamics

Threadfin Shad

125. Threadfin shad and the striped bass x white bass hybrid were the only fish species stocked in the reservoir. No threadfin shad were found in the preimpoundment survey (Shelton and Davies 1977). The threadfin shad population has rebounded from the severe winters of 1976-77 and 1977-78 to the extent that they now are an important part of the fish community (Fig. 18 and 19). The number per hectare collected from cove sampling and associated E values in 1980 (compared to 1977, 1978 and 1979) demonstrate the decline and recovery (Table 40). Given a series of mild winters, threadfin shad should occupy an even greater portion of the total fish biomass.

126. The high water conditions (>193 m msl) and flooding of terrestrial vegetation in 1980 appeared to have favored reproductive success. Water level management directed toward enhancing largemouth bass reproduction should have benefited the threadfin shad population. This prey species is important for largemouth bass but will become increasingly significant as a forage base for the expanding hybrid striped bass population.

Table 40

The percentage by weight (E values) of a species based on total standing stock determined from large cove rotenone samples West Point Lake, Alabama-Georgia, 1975-1980.

	1975	1976	1977	1978	1979	1980
Bowfin	6.3	1.3	0.8	0.1	0.6	--
Threadfin shad	2.1	2.9	1.4	2.2	4.1	8.4
Gizzard shad	26.5	64.0	46.9	43.2	62.2	32.0
Redfin pickerel	1.7	0.2	0.6	T	T	--
Carp	6.4	4.0	8.5	11.6	8.2	20.2
Golden shiner	3.6	0.2	0.5	T	T	T
Blacktail shiner	T	T	T	T	T	--
Quillback sucker	3.6	T	--	T	--	--
Spotted sucker	3.2	0.2	0.8	0.2	0.4	0.2
Undescribed redhorse	0.1	T	0.1	0.1	T	--
Creek chubsucker	1.2	1.2	0.8	T	T	--
Snail bullhead	T	T	T	T	0.1	0.4
White catfish	--	--	--	--	0.1	0.3
Yellow bullhead	0.4	0.2	T	T	T	--
Brown bullhead	7.3	5.8	4.6	3.4	1.5	0.2
Black bullhead	T	T	T	--	T	T
Channel catfish	2.4	1.2	0.4	1.0	0.7	1.5
Mosquitofish	T	T	T	T	T	T
Brook silverside	T	T	T	T	T	T
Flier	1.2	1.1	0.4	T	T	--
Warmouth	1.1	0.9	0.4	0.4	0.4	0.7
Redbreast sunfish	0.6	1.1	1.1	2.9	0.4	0.5
Green sunfish	3.3	1.3	0.8	0.6	0.1	T
Bluegill	7.8	6.6	19.1	29.1	16.9	27.5
Redear sunfish	0.5	0.7	0.4	0.4	0.3	0.2
Spotted sunfish	0.5	0.3	T	T	T	T
Spotted bass	0.4	T	T	T	T	T
Largemouth bass	8.7	4.4	8.9	2.5	2.6	2.4
Black crappie	11.6	2.2	3.4	1.4	0.7	4.2
Yellow perch	0.2	0.1	0.1	0.8	0.5	0.8
Swamp darter	--	T	T	T	T	T
Hybrid striped bass	--	--	--	0.1	T	--
Mean standing stock (kg/ha)	390	363	934	285	596	320

T = Trace (<0.1%)

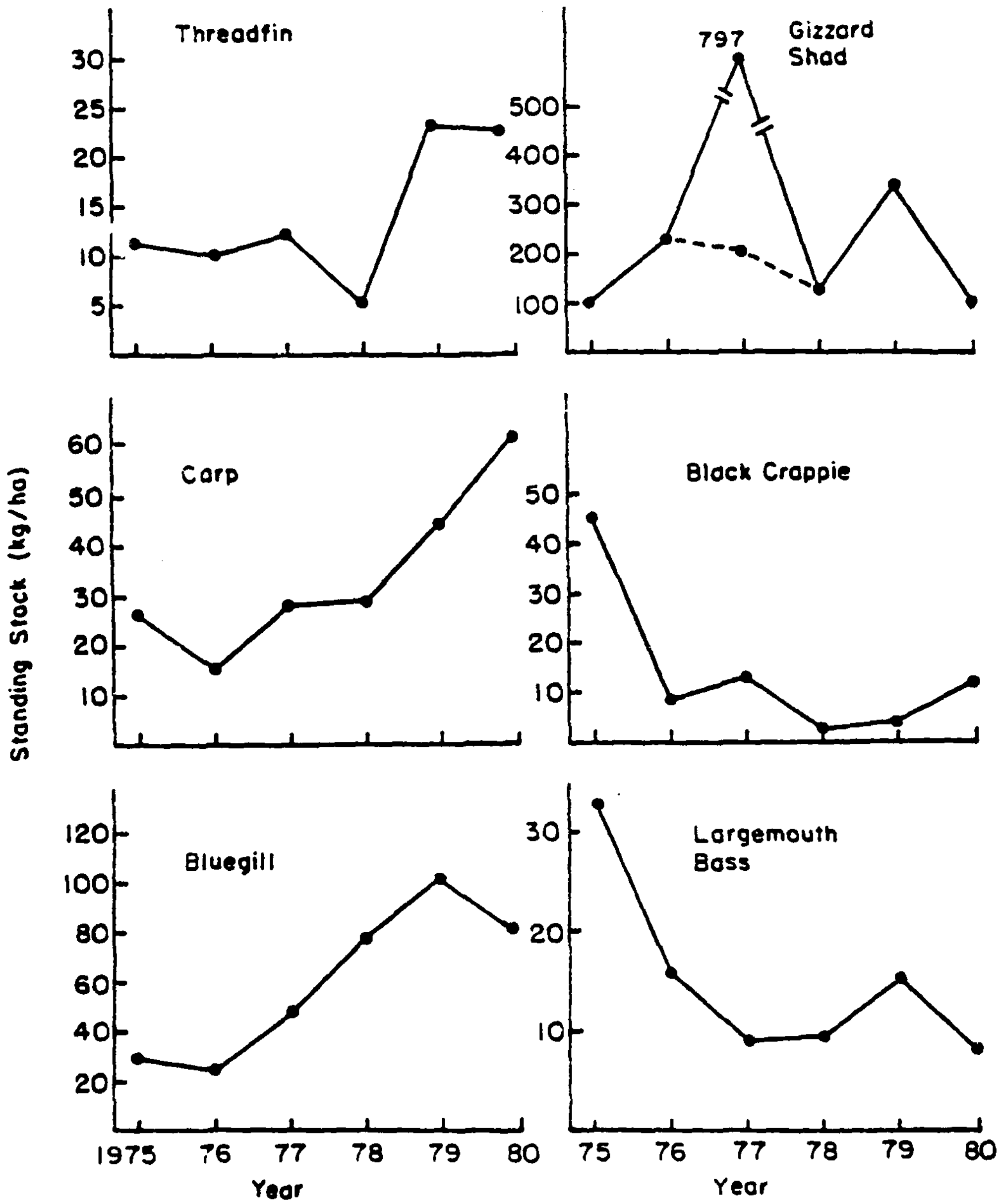

Figure 18. Biomass estimates of important species in West Point Lake, Alabama-Georgia, (1975-1980) from cove rotenone samples.

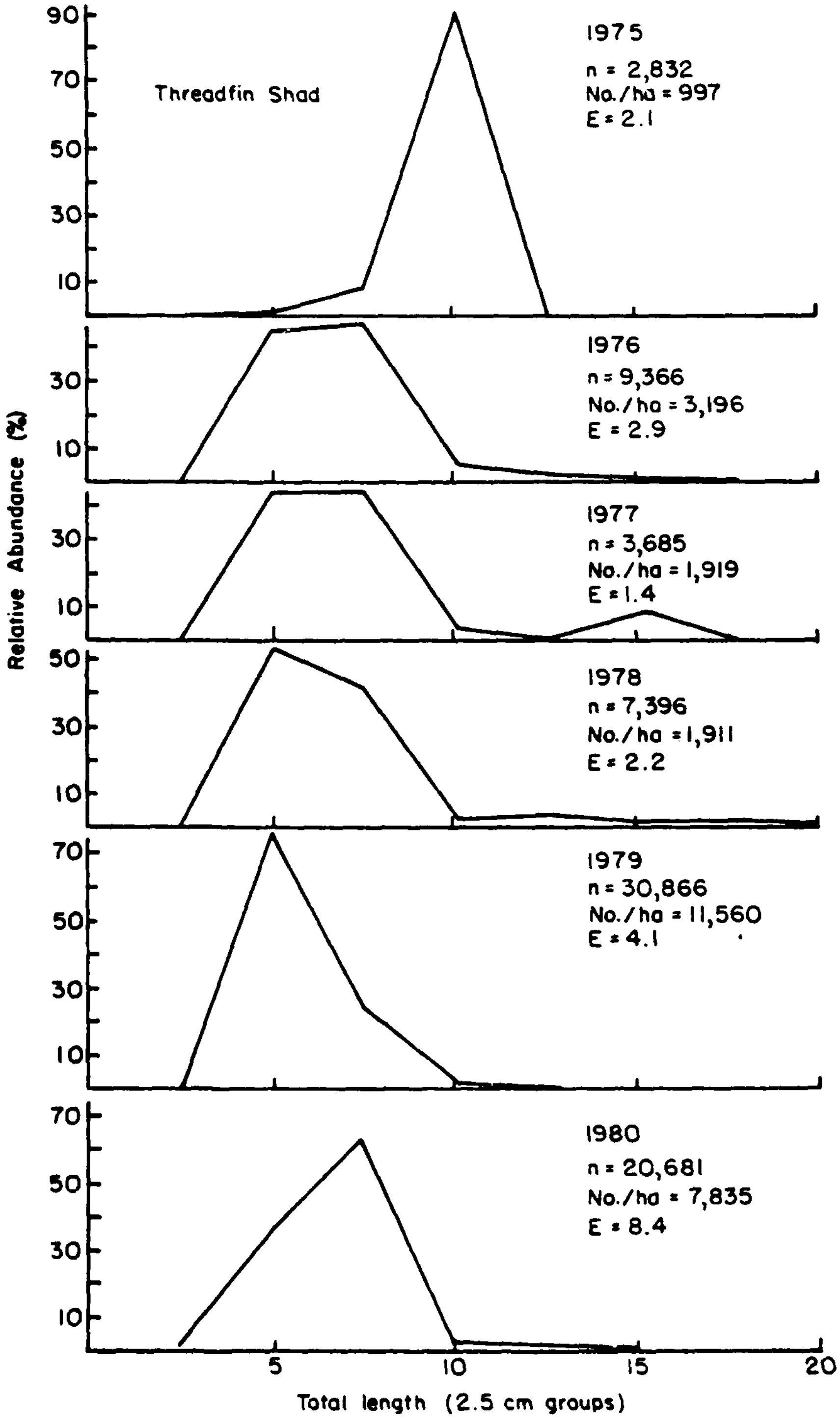

Figure 19. Length-frequency distribution of threadfin shad (1975-1979) and associated E values, West Point Lake, Alabama-Georgia, from cove rotenone samples.

Gizzard Shad

127. Gizzard shad have consistently composed a significant portion of the total biomass in the reservoir (Table 40), and in a few coves they were so abundant as to dominate the sample (Cove II, 1977). If this cove is not considered, the trend in standing stock is somewhat more consistent (Fig. 18). In this respect gizzard shad may have reached an equilibrium condition where standing stock will fluctuate between 100-200 kg/ha (or approximately 50% of total fish biomass).

128. During the last two years (1979-1980), relatively few young of the year were present in the rotenone samples (Fig. 20). As a result, the length-frequency distribution has been dominated by shad in the 15-20 cm range. It may be significant that fish are not accumulating at a larger size as indicated by the length frequency distribution for the last two years.

129. The water level was managed in 1979 and 1980 to enhance largemouth bass spawning and should have also favored shad reproductive success. However since peak spawning for gizzard shad is about one month earlier than bass and threadfin shad, the conditions may not have been as favorable. The water level rose abruptly in March-April, 1979, and fluctuated several meters until it stabilized 0.5 m above normal summer pool in late April (Fig. 21). This fluctuation may have exposed deposited eggs and reduced hatching which we considered as a possible explanation for year class failure. However during 1980, the water level pattern should have been conducive to spawning success (Fig. 21). As an alternative hypothesis, density dependent factors may be involved such as competition for food affecting growth and fecundity of the species. The absence of very large shad in the population (>30 cm) signifies relatively slow growth, a condition possibly resulting from low levels of plankton production (Bayne et al. 1980). The gizzard shad population represents abundant prey for large predators in the reservoir (Fig. 20). However, only largemouth bass longer than about 30 cm can effectively prey on most of the shad of the size sampled in 1980. The shad are extensively utilized as food by largemouth bass longer than about 30 cm but bass feed primarily on bluegill up to this size.

Common Carp

130. Large numbers of young-of-the-year carp were present in the population only during 1975 (initial year class). From 1975 through 1980, the population was dominated by the initial year class (Fig. 22). The increase in E values and standing stock (Table 40, Fig. 18) since 1975 has been a function of growth of individuals in this year class rather than through recruitment. Carp have been observed spawning each year, however. The low rate of recruitment must be related to natural mortality after egg deposition. Bluegills have been observed feeding where carp spawned and fish eggs were found upon analysis of bluegill guts (Shelton et al. 1981). The "egg eating" habit of bluegills has

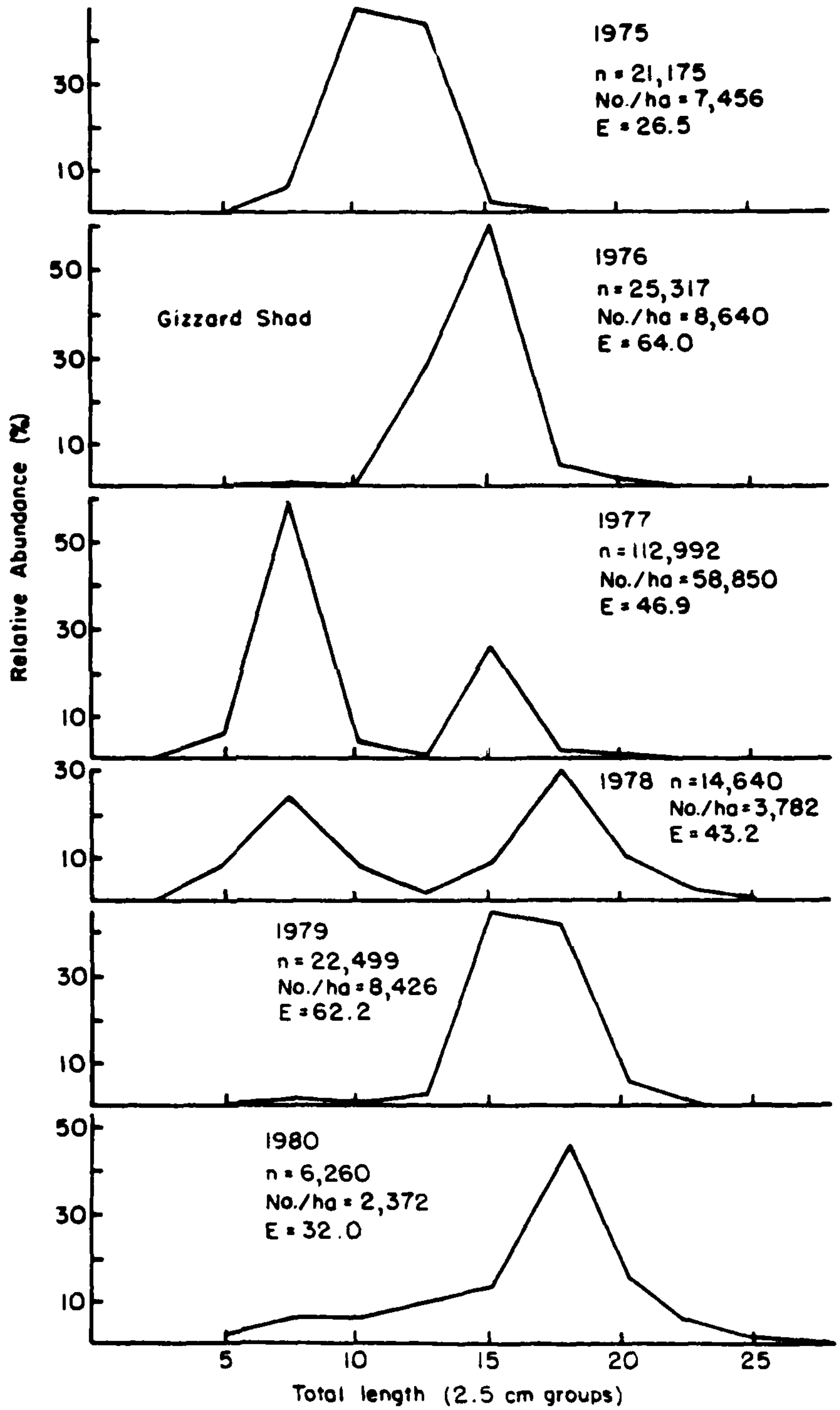

Figure 20. Length-frequency distribution of gizzard shad (1975-1980) and associated E values, West Point Lake, Alabama-Georgia, from cove rotenone samples.

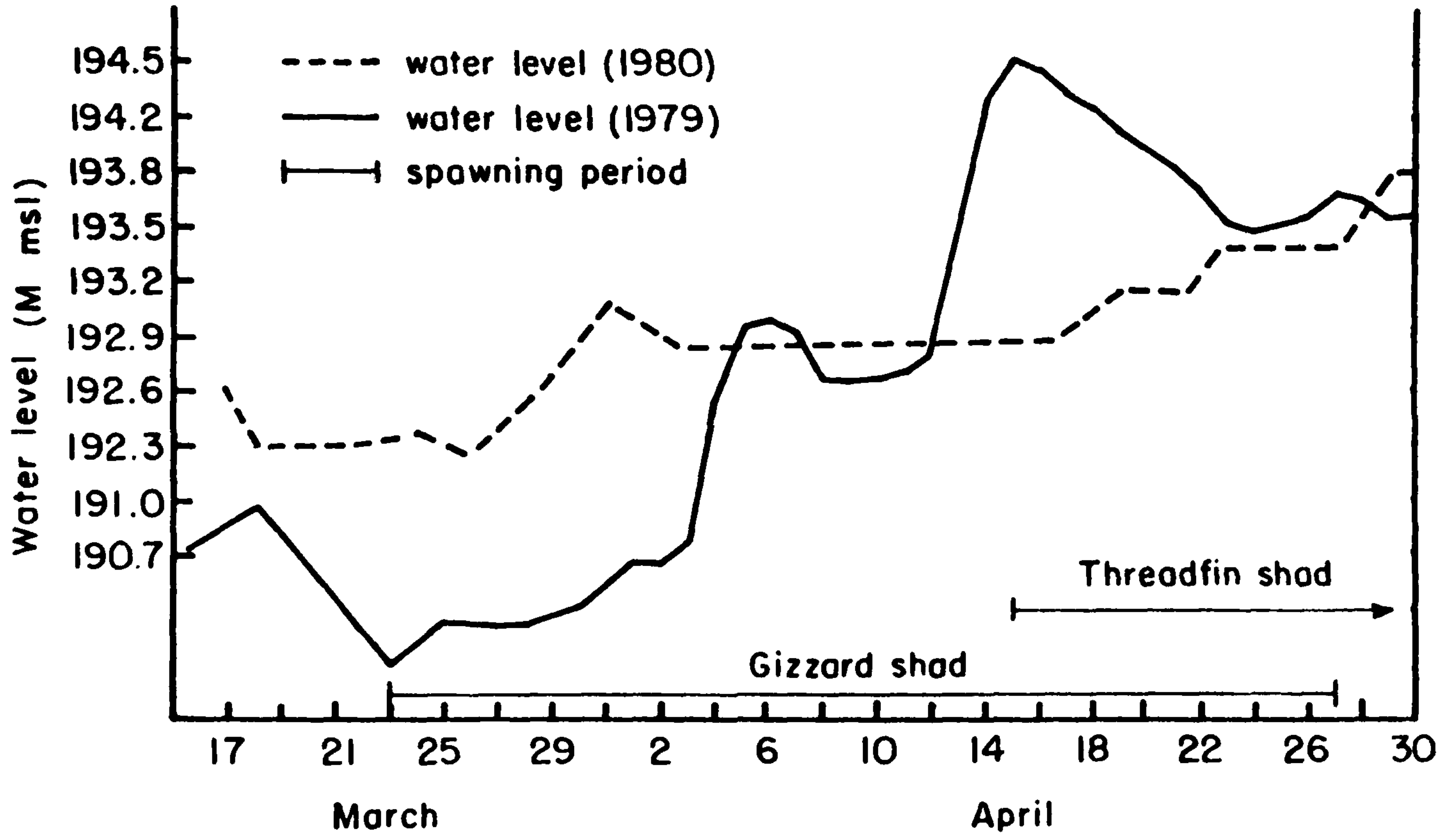

Figure 21. Water level patterns during early spring 1979 and 1980, and probable spawning periods for gizzard and threadfin shad.

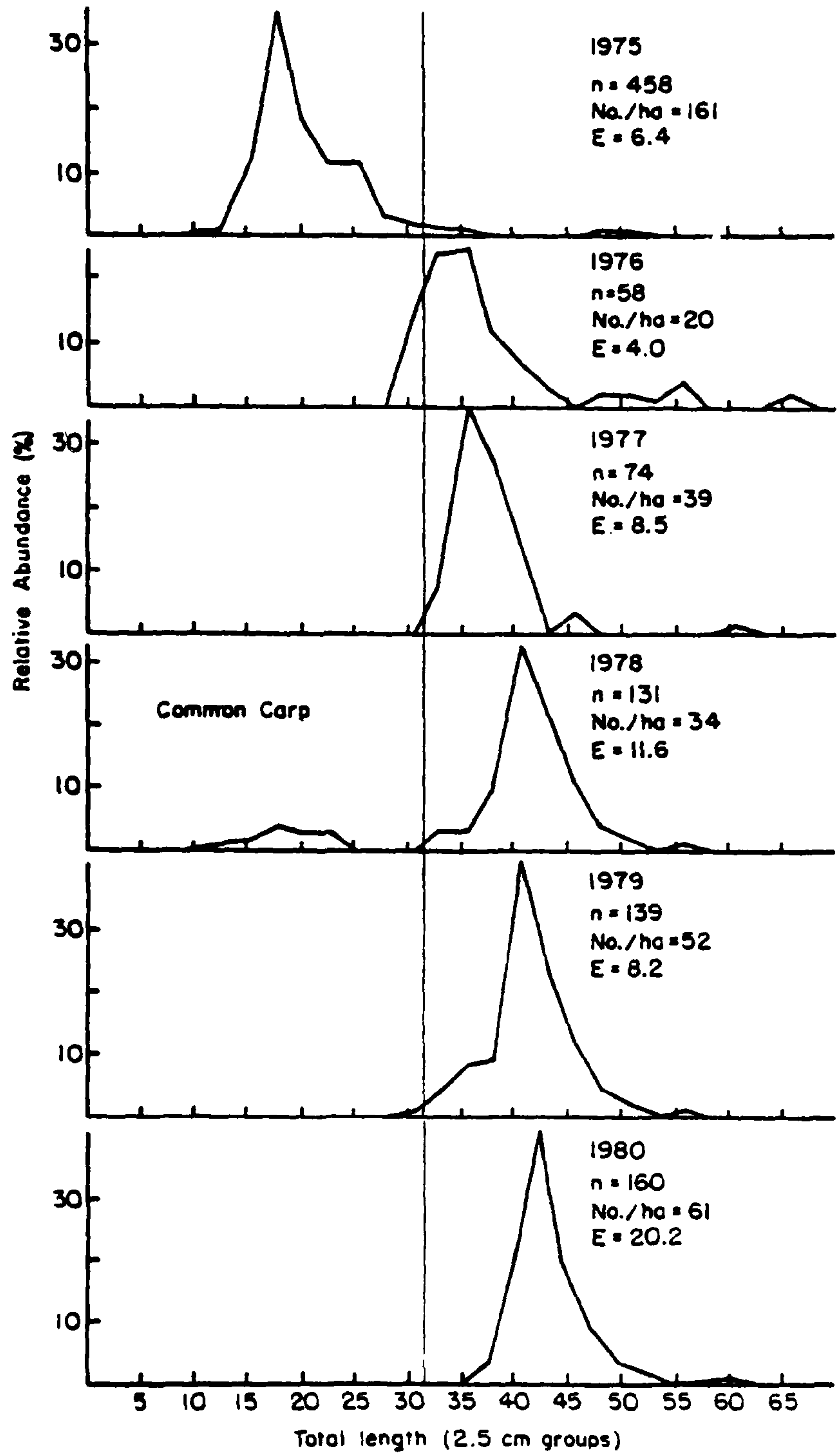

Figure 22. Length-frequency distribution of common carp (1975-1980) and associated E values, West Point Lake, Alabama-Georgia, from cove rotenone samples.

been documented in bass-bluegill stocked farm ponds and does, in fact, limit recruitment of both species (Swingle 1950).

131. Predation of young-of-the-year largemouth bass on young-of-the-year carp did not appear to have been a significant factor in reducing their numbers even though size distribution of the adult carp appears to be a pattern associated with predation similar to that described for largemouth bass-bluegill populations crowded with bass (Harders and Davies 1974). Predatory pressure may have involved juvenile largemouth bass that were not as well represented in the marginal or electrofishing samples.

Bowfin

132. Bowfin have persisted only to a very limited extent in West Point Lake. The initial year class was successful, comprising 6.3% of the first years' biomass (Table 40). Bowfin growth was rapid during the first several years (1975-1976) but no measurable recruitment has occurred since the initial year of impoundment. The bowfin populatior has gradually declined; none were collected in cove rotenone sampling during 1980.

Brown Bullhead

133. Annual recruitment, subsequent to initial spawning, in the reservoir has been light. The 1975 year class continues to suffer natural mortality and to an increasing extent fishing mortality. Predation by largemouth bass may limit recruitment of bullheads and the population will continue to dwindle to some minimal level. This was evident from the results of cove rotenone samples in 1979 and 1980 where the absolute number sampled has further diminished.

Black Crappie

134. The initial (1975) year class of black crappie began entering the fishery in 1977 as 14-20 cm fish, a size not usually considered acceptable to fishermen (Fig. 23). The contribution of the 1975 year class to the creel declined in 1978 even though the total harvest increased due to the influx of the 1977 year class (at age II+). In 1980, crappie continued to be the dominant species in the creel. The availability of harvestable-size crappie may be considerably underestimated by cove rotenone samples in light of the harvest information (see Harvest section). The two primary means of estimating the population structure, electrofishing and rotenone, are less effective for crappie than for other species because of their off-shore distribution in the reservoir. Trap net sampling in the fall collected relatively large numbers of harvestable-size (>23 cm) fish (Fig. 23).

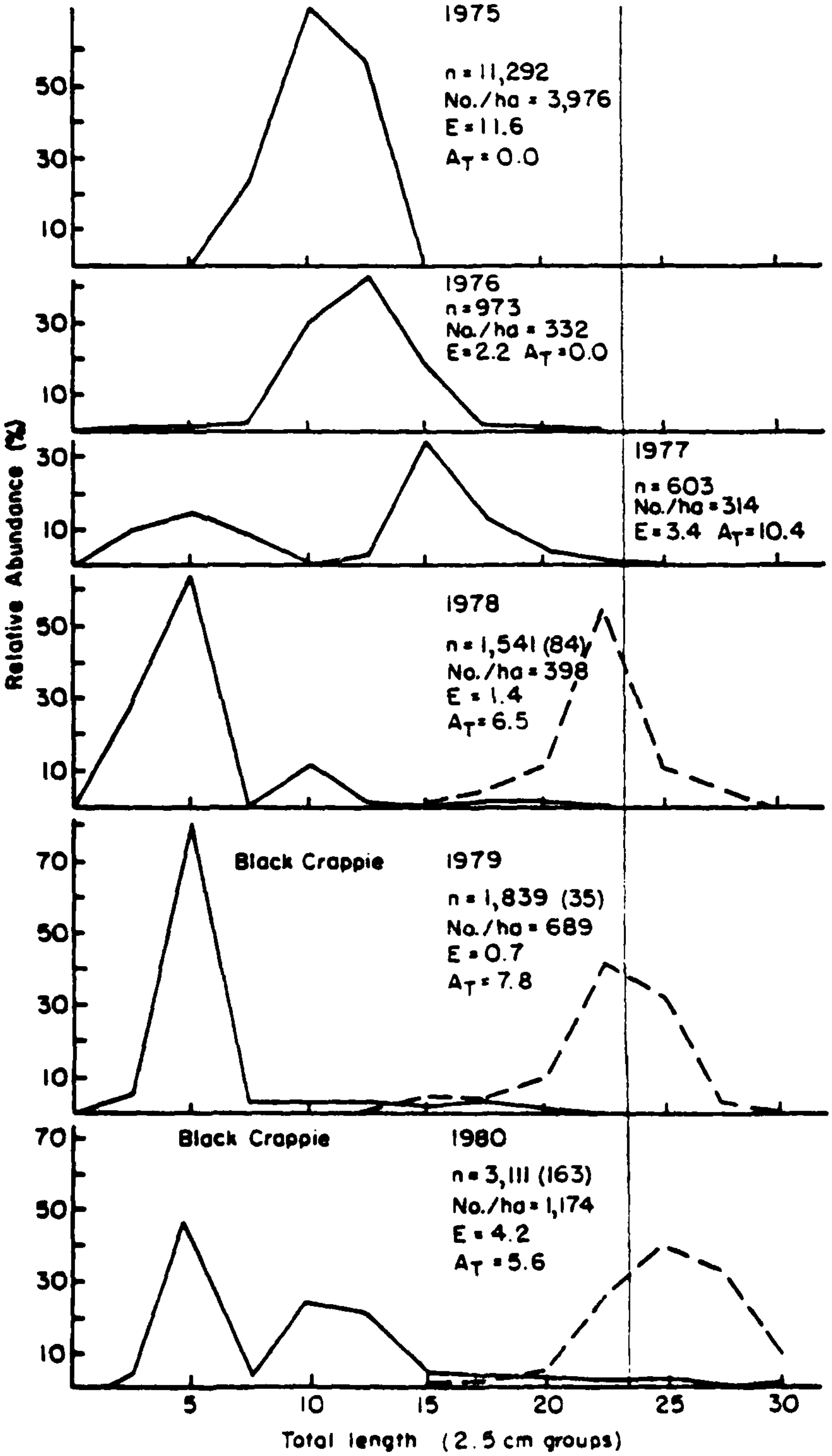

Figure 23. Length-frequency distribution of black crappie (1975-1980) and associated E values, West Point Lake, Alabama-Georgia, from cove rotenone samples. Vertical line represents minimum harvestable size; parenthetic numbers and dashed lines for 1979-1980 are from trap netting.

135. Judging from the growth expressed by the initial year class, crappie in West Point Lake cannot be expected to reach harvestable size (>23 cm) until their fourth year of life (III+) although they may be retained by fishermen at a smaller size. The crappie population should benefit (increased growth) by the resurgence of threadfin shad in the reservoir as we feel that prey availability for crappie has been the main limiting factor affecting growth. Crappie fishing success should increase over the next 2 to 3 years as the 1978, 79 and 80 year classes begin to enter the quality-size range (>23 cm). The cyclic nature of crappie populations in smaller impoundments is not typical for large impoundments and it appears that in West Point Lake crappie dynamics will be characterized by slow growth but steady recruitment into the fishery at a size that is not normally considered to be harvestable.

Bluegill

136. Unlike many fish species in the reservoir, bluegill have spawned successfully each year and continue to represent a signficant portion of the total biomas (Fig. 24). The standing stock of bluegill (Fig. 18) may have reached an equilibrium level in the reservoir (80-100 kg/ha). In 1980, only gizzard shad standing stock (100 kg/ha, E = 31.0) equaled that of bluegill (E = 27.4) in this respect (Table 40). However relatively few bluegill are of harvestable size (<20% by weight) as is reflected in the diminishing contribution that bluegill are making to the creel (see Harvest section).

137. The catch rate of large bluegill is low when compared to well managed bass-bluegill stocked farm ponds where harvestable-size fish usually comprise 40-60% of the total weight. The relatively high percentage of harvestable-size fish during 1975, 76, and 77 (36, 49, and 41% respectively) can be attributed to the rapid growth expressed by those individuals already in the system at the time of impoundment. Growth of bluegill into the harvestable-size range is obviously less than that expected from a well managed farm pond. Alternatively, the normal water level fluctuation in a reservoir operated for flood control adversely affects benthic invertebrate production (Kaster and Jacobi 1978) and, in this way, impacts the fish populations that feed on invertebrates.

Striped Bass x White Bass Hybrid

138. Hybrid striped bass stocking was continued during 1980 on West Point Lake by the Georgia Department of Natural Resources. Both fry and fingerlings (Table 41) were stocked at two locations on four dates (Frank Ellis, Personal Communication)[1]. The stocking rate for both fingerlings and fry in 1980 was 158 per hectare compared to approximately 84 and 150 per hectare stocked in 1978 and 1979 respectively (Table 42). Although fry stocking has generally not been considered as significant as fingerling stocking, Bishop (1968) found

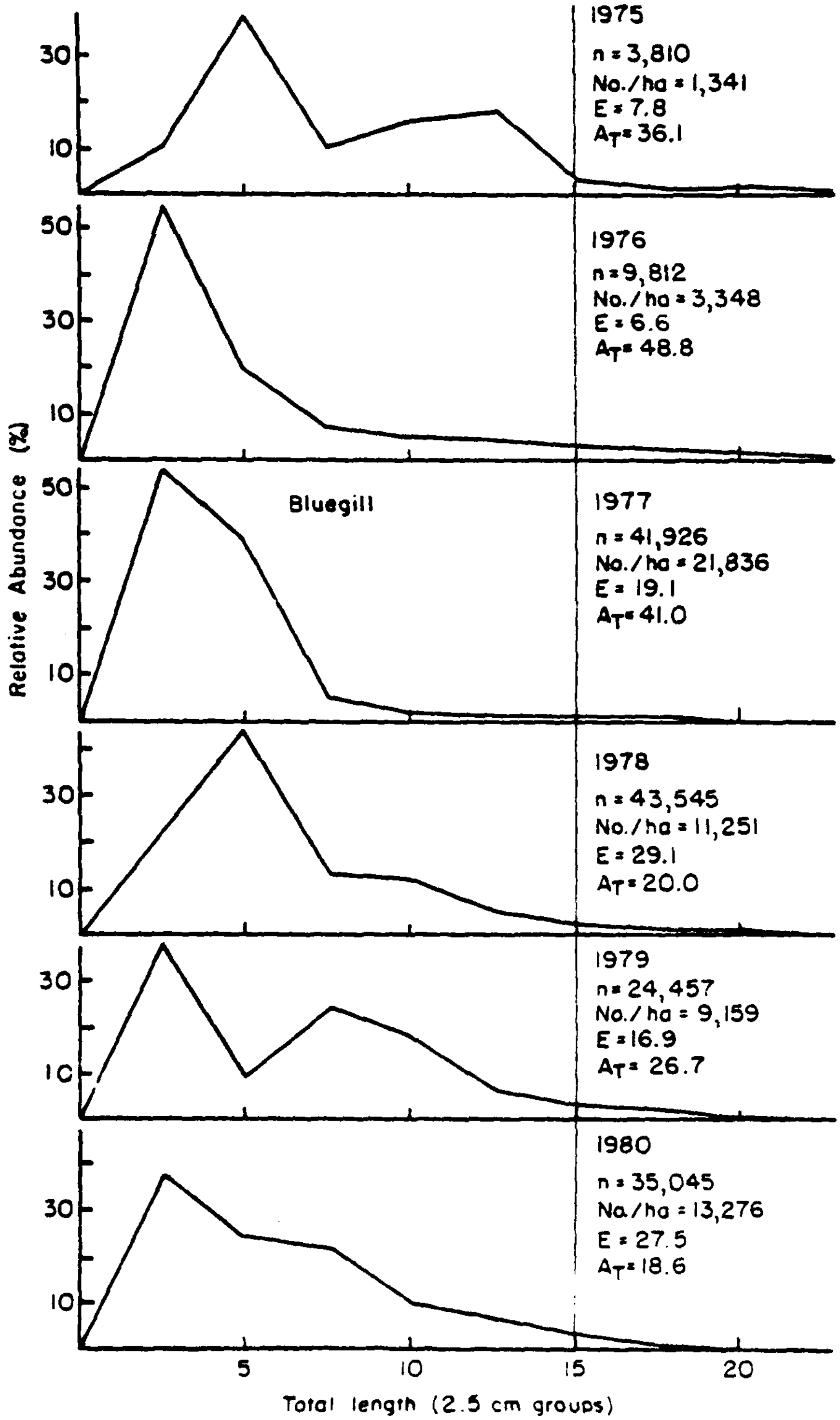

Figure 24. Length-frequency distribution of bluegills (1975-1980) and associated E values, West Point Lake, Alabama-Georgia, from cove rotenone samples. Vertical line represents minimum harvestable size.

Table 41

Stocking information on hybrid striped bass in West Point Lake, Alabama-Georgia, 1980.

Date	Size (mm)	No. stocked	Location (access)
April 12	Fry	1,485,000	Glass Bridge
May 15	Fingerling (18-35)	71,000	Yellowjacket Creek
May 22	Fingerling (24-32)	29,500	Glass Bridge
May 23	Fingerling (25-50)	68,800	Yellowjacket Creek

Table 42

Summary of stocking information for hybrid striped bass (no/ha), West Point Lake, Alabama-Georgia, 1979-1980.

Year	Fry	Fingerling	Total
1978	71	13	84
1979	105	45	150
1980	142	16	158

fry survival approaching 15% in Tennessee. Fingerling stocking in West Point Lake (13-14/ha) has been within the most frequently used range (Prichard et al. 1977).

139. Gill netting in early February, 1980 captured fish from both the 1978 and 1979 year classes with weights ranging from 1.5-2.0 and 0.25-0.45 kg respectively. A length-frequency distribution based on rotenone collections (July-August 1978-1979) and back-calculated lengths of hybrids collected from October 1979 through May 1980 (Fig. 25) demonstrates reasonably good growth. Of interest is that portion of the 1979 year class represented by the first modal length (as Age I). This group of individuals was collected by electrofishing at night. These fish were feeding exclusively on insect larvae (Chironomidae) and had not transitioned to fish as prey.

140. Most anglers interviewed have indicated an interest in the hybrid and are aware that the Georgia Department of Natural Resources is responsible for the stocking program. A fishery developed during July, August and September; anglers fished late afternoon and early morning exclusively for hybrids in areas adjacent to the old river channel.

Largemouth Bass

141. The change in the size structure of the largemouth bass population during the period 1975 through 1980 is depicted in Figure 26. The initial year class (1975) virtually disappeared from the fisherman's creel by 1977 (Bayne et al. 1980). Mortality associated with the fishing process (106.2 hr/ha) during 1976 and the spring of 1977 was the probable cause of the rapid demise. In subsequent years (1977-78) fishing effort declined (77.6 hr/ha); however during 1979-1980 there was a resurgence of fishing effort on the reservoir (see Harvest section).

142. Length-frequency distributions have been dominated by sub-harvestable size fish because of high reproductive success. As a result, the harvestable-size fish in the population appear to be poorly represented. Figure 27 relates size structure to abundance and illustrates the relative stability in number and biomass of harvestable-size (≥25 cm) largemouth bass.

143. The abundance of young-of-the year largemouth bass has been influenced by a program of water level management that was initiated in 1978. Marginal rotenone sampling has provided an efficient means of monitoring the production and abundance of young-of-the-year largemouth

[1] Frank Ellis, Biologist, Georgia Department of Natural Resources, Manchester, Georgia.

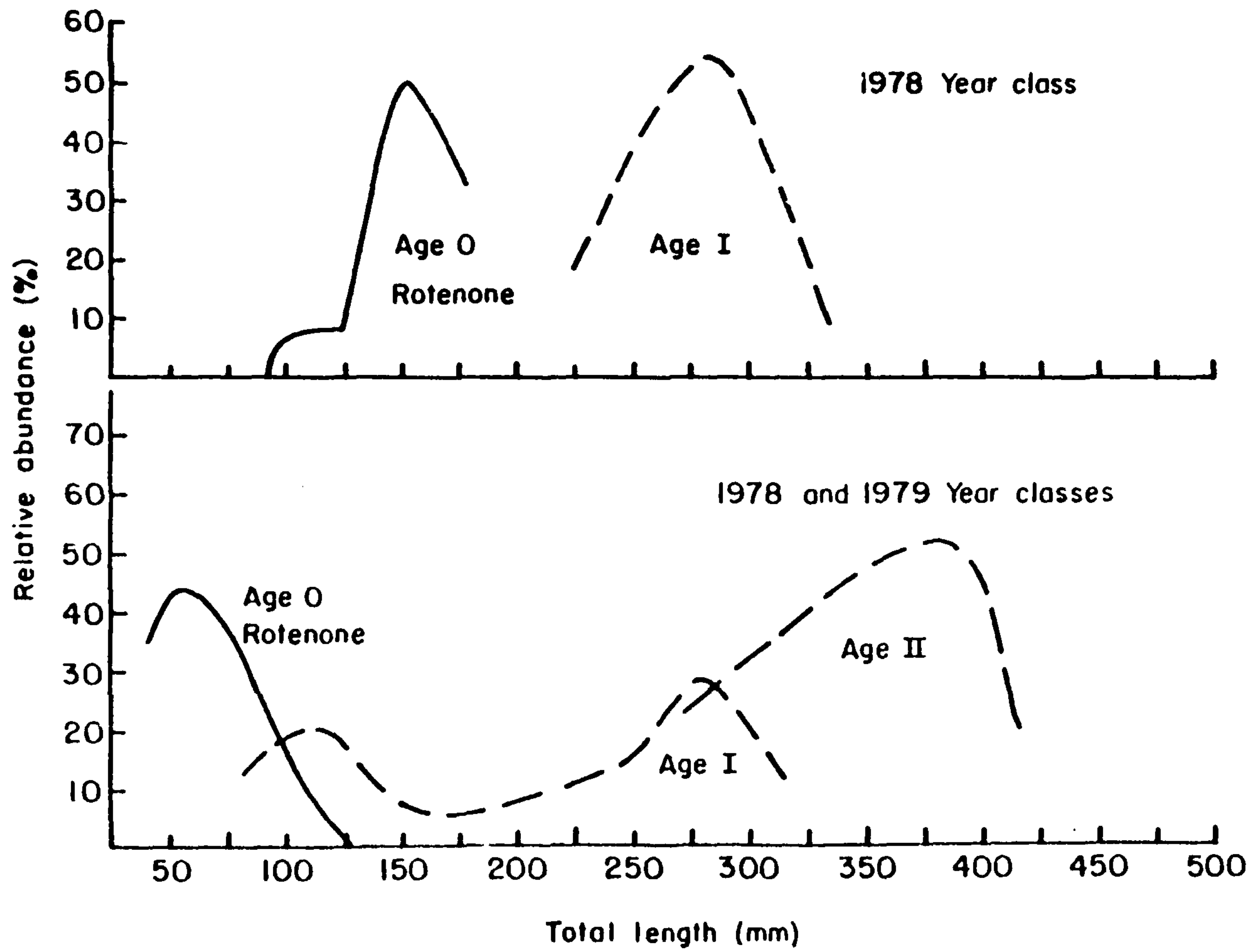

Figure 25. Hybrid striped bass length-frequency determined from August rotenone and gill-netting throughout the year. Upper collections were made in 1978 and 1979; lower samples were collected in 1979 (solid line) and 1980 (dashed line). The 1980 data represent back-calculated lengths for the 1978 year class.

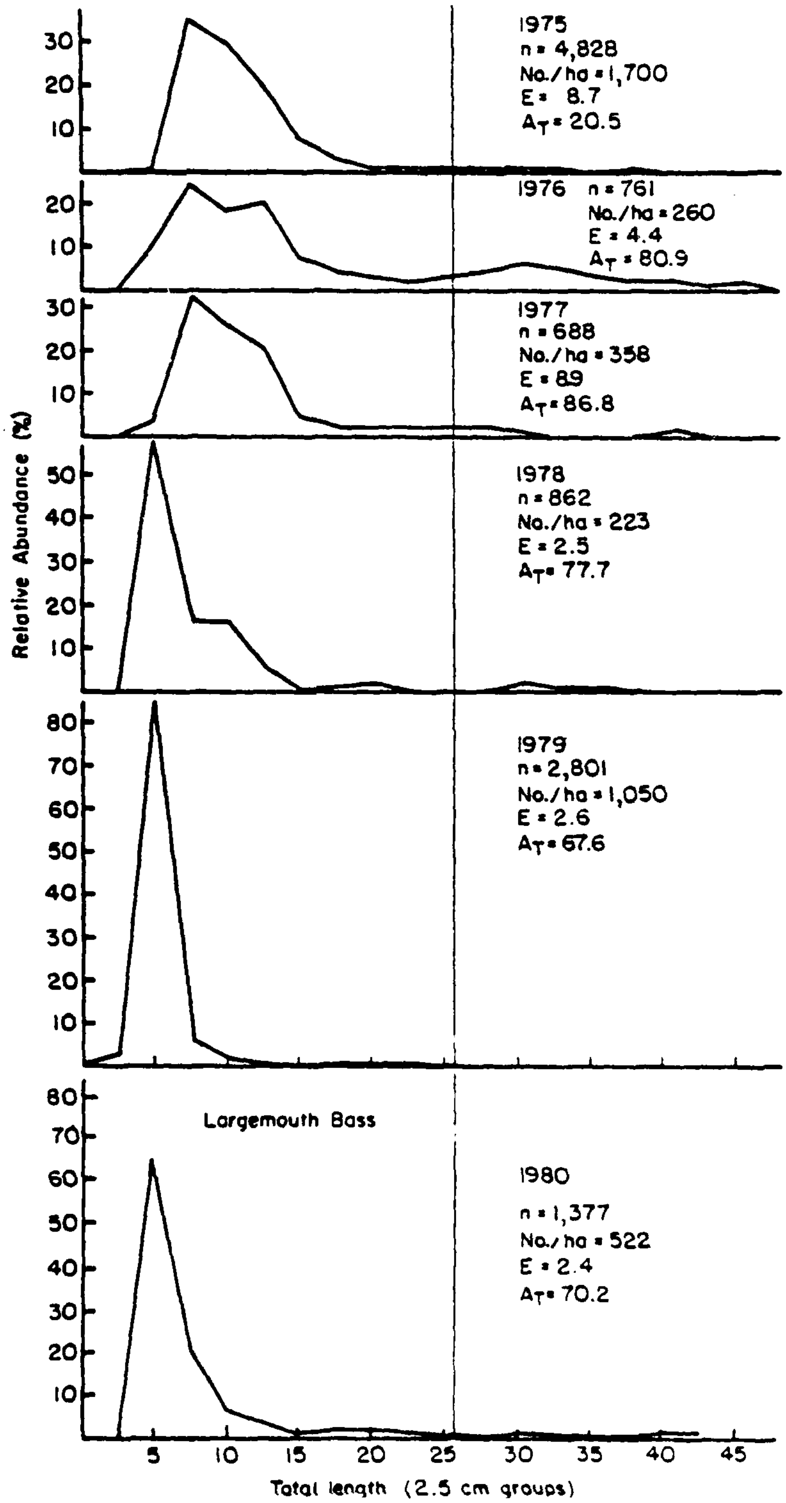

Figure 26. Length-frequency distribution of largemouth bass (1975-1980) and associated E values, West Point Lake, Alabama-Georgia, from cove rotenone samples. The vertical line represents minimum harvestable size.

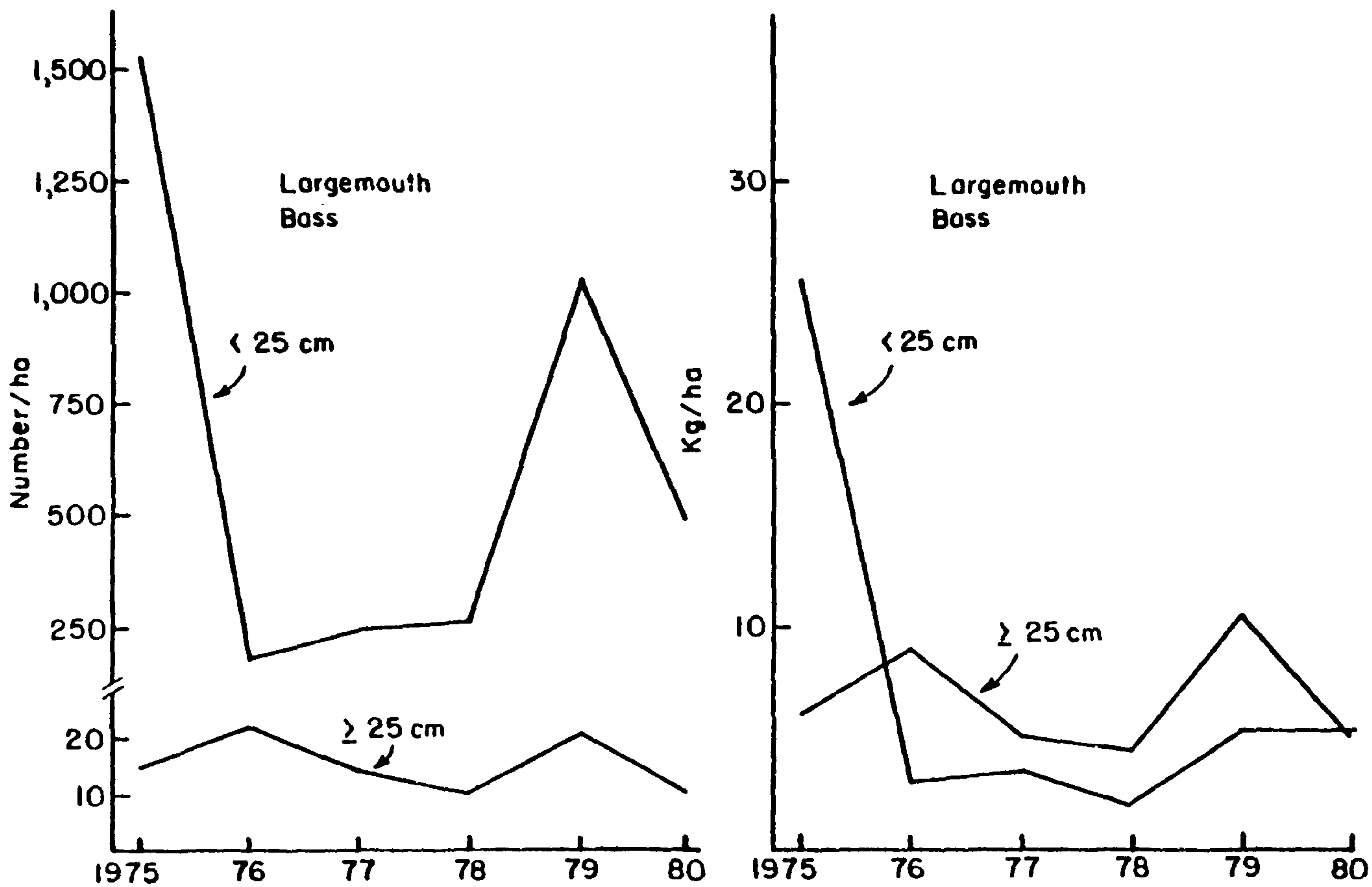

Figure 27. Changes in numbers and biomass of harvestable and sub-harvestable largemouth bass (1975-1980), West Point Lake, Alabama-Georgia, from cove rotenone samples.

bass. An acceptable year class was produced in 1977 with recruitment of approximately 100-200 young/ha (Fig. 28). Water management during 1977 represents a normal operating schedule where the level usually is maintained at or near summer pool during the spring and summer.

144. During 1978 the Corps, as requested, maintained the water level approximately 0.5 m above summer pool from the pre-spawning period until mid-July. Marginal sampling indicated a decline in number of young-of-the-year to a density approximating that of the previous year or about 200/ha (Fig. 28). The increased number of young bass early in the season was attributed to the protection (cover) provided by flooding approximately 400-500 hectares of new littoral zone with its associated terrestrial vegetation.

145. During 1979 and 1980, the water level was maintained above summer pool until later in the year to provide better conditions for bass survival for a longer period of time and hopefully influence recruitment at a larger size. The rate of decline during the summer was reduced compared to previous years (Fig. 28), and the number of largemouth bass present in the August-September period was somewhat higher (200-400/ha) than in previous years.

146. The increase in young bass observed in 1979 and 1980 was expected to enhance recruitment in the fishery. However, growth patterns have been affected by the abundance of young bass and may be a major limiting factor affecting recruitment. Growth retardation may be limiting in that the prey species could grow to a size where they are unavailable as food thus affecting recruitment.

147. Growth of young-of-the-year largemouth bass under the water level management regimes during 1977-80 reflects not only the absolute number produced but competition for available prey. In each year a bimodal length distribution was developed by the August-September period (Fig. 29). Growth, especially associated with the more advanced modal group, obviously was better in 1977 than in subsequent years (1978, 1979, and 1980) when the numbers of young present were substantially greater.

148. Growth as a function of number present and resulting mortality can be expressed as an instantaneous daily rate (G). In this respect, daily growth in 1977 (base year) was 0.041 (Bayne et al. 1980) compared to 0.029 for the 1980 year class. Flooding of terrestrial vegetation during the spring and summer months should have generated a greater prey abundance, particularly bluegills, in addition to stimulating a successful largemouth bass spawn. Any additional prey, however, was evidently not sufficient in quantity or of an appropriate size to compensate for the large numbers of young largemouth bass.

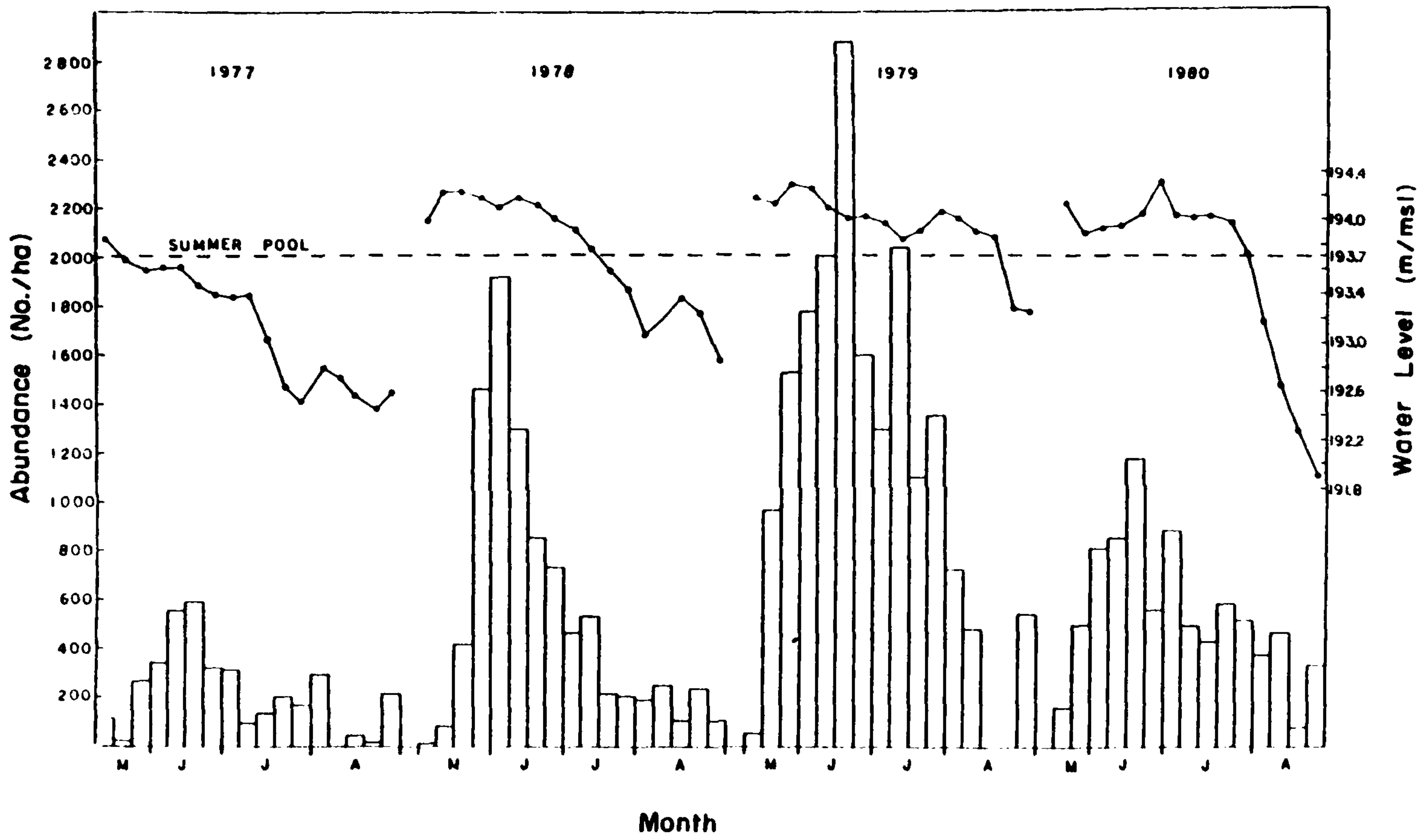

Figure 28. Relationship between water level and mean number of young-of-the-year largemouth bass collected by marginal rotenone sampling (1977-1980), West Point Lake, Alabama-Georgia.

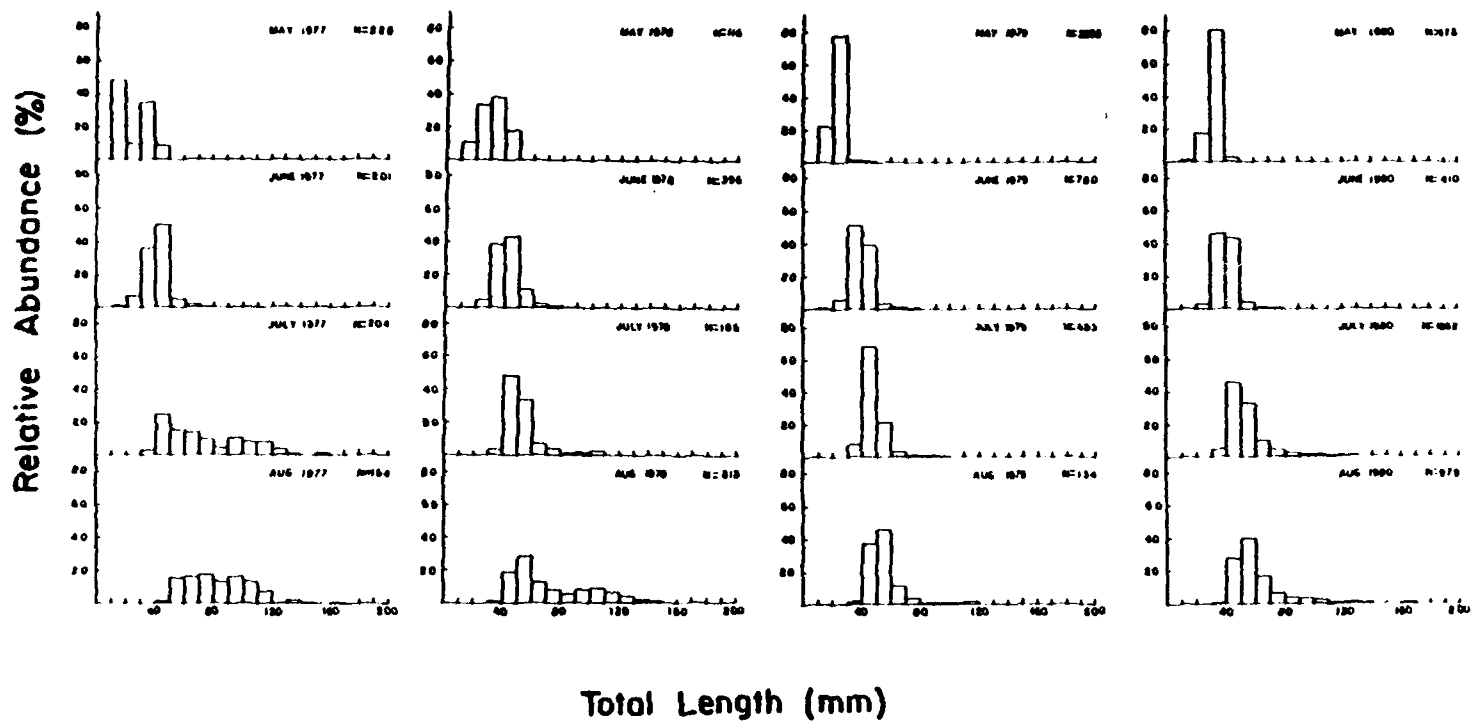

Figure 29. Young-of-the-year largemouth bass collected by marginal rotenone sampling (1977-1980), West Point lake, Alabama-Georgia.

149. In well fertilized farm ponds with balanced fish populations, bluegill continue to spawn throughout the summer months. This provides suitable size prey for bass over an extended period as they transition to a piscivorous diet. In contrast, bluegill in West Point Lake have a spawning peak in early summer, but spawn sparingly throughout subsequent months. Monthly length frequencies for bluegill (Fig. 30) during 1980 illustrates the relative scarcity of small sized bluegill available to young-of-the-year bass. West Point Lake is typical of many mainstream reservoirs that do not accumulate nutrients, and may not provide optimum conditions for bluegill growth and reproduction. Also normal water level management in a typical flood control reservoir adversely affects benthic invertebrates (Shelton et al. 1981); consequently, the food for bluegill may be insufficient.

Predator-Prey Relationships

150. A composite available-prey/predator plot (AP/P) based on the analysis proposed by Jenkins and Morais (1978) was constructed for the 1980 cove rotenone date (Fig. 31). Based on these data, adequate prey was available for all sizes of predators ("Bass equivalents"); the relationship for 1980 implies prey availability similar to that in 1977 (Fig. 28).

151. During 1977 and 1980, there was a greater relative abundance of prey than in other years (Figs. 31 and 32). Strong year classes of bluegill, crappie, and shad occurred in both years that shifted the general relationship upward from that observed in other years. These data support the hypothesis that the fish populations have reached a state of equilibrium where excess prey is present at least with reference to those predators in the larger size groups. However, based on littoral rotenone sampling (Fig. 33) there appears to be a paucity of prey for smaller size (<10 cm) bass.

152. Predator-prey relationships based on AP/P analyses assumes that if prey of a size capable of being swallowed is present, it is available and therefore will be utilized. This premise has been evaluated during the past 3 years by examining actual lengths of prey eaten by largemouth bass (Figs. 34 and 35). The data suggest a well-defined tendency for larger bass to eat larger prey, thus the larger predators are not utilizing the smaller size prey that are assumed to be available with AP/P interpretation. Therefore for certain sizes of largemouth bass, prey may actually be in short supply if the predator does not feed on fish smaller than a preferred size.

153. Food-habit studies of largemouth bass have also reaffirmed the well-defined transition from an invertebrate to a piscivorous diet in the size range of approximately 50 to 75 mm (Bayne et al. 1980) but further analyses have suggested another shift not previously defined. Largemouth bass in the size range of 50 to 300 mm feed primarily on bluegill (Figs. 34 and 35) but at lengths longer than 200 mm they

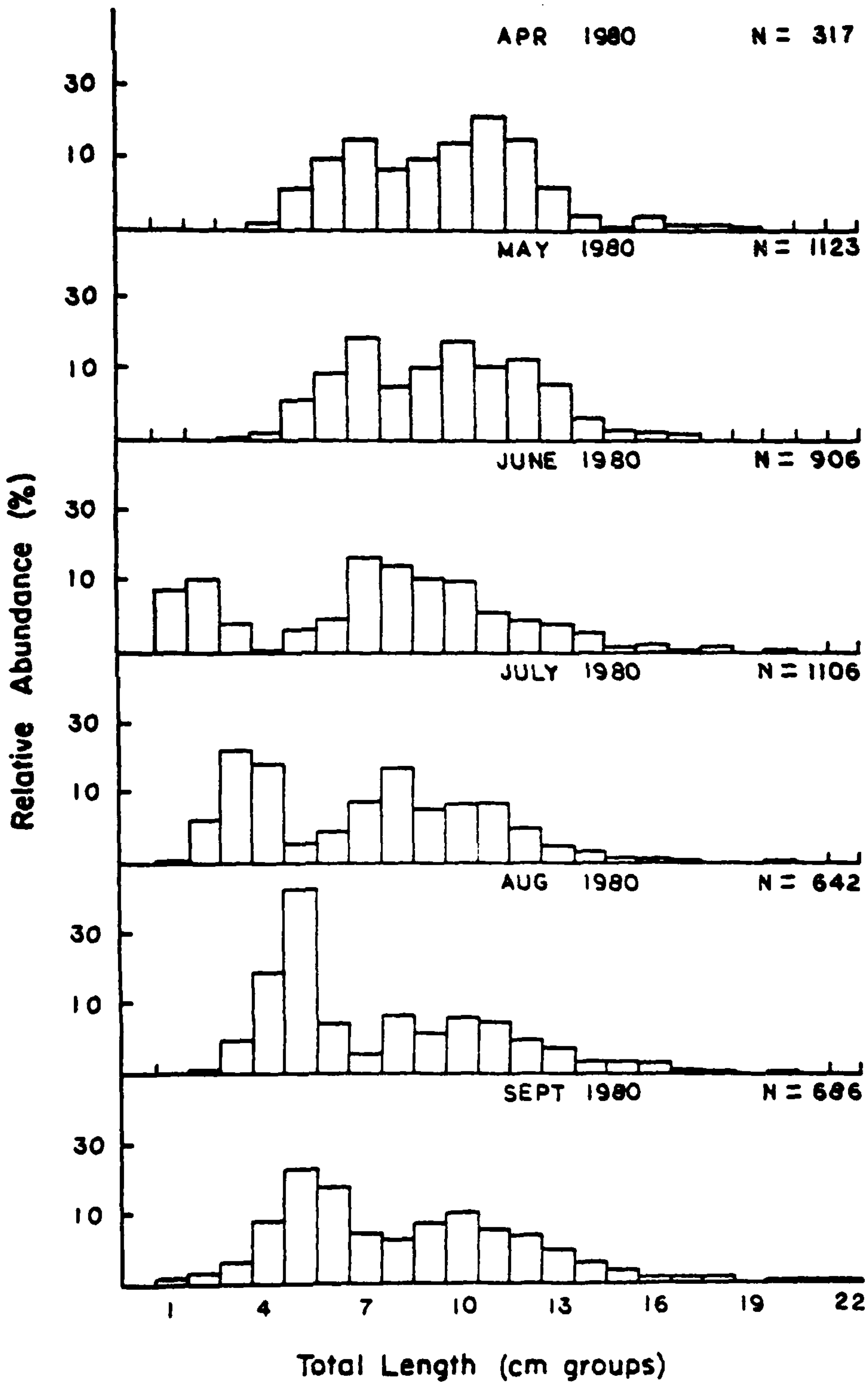

Figure 30. Length-frequency distribution of sunfishes (Group 1 < 1.5 cm; Group 2 $\geq$ 1.5 < 2.5 cm) from West Point Lake, Alabama-Georgia.

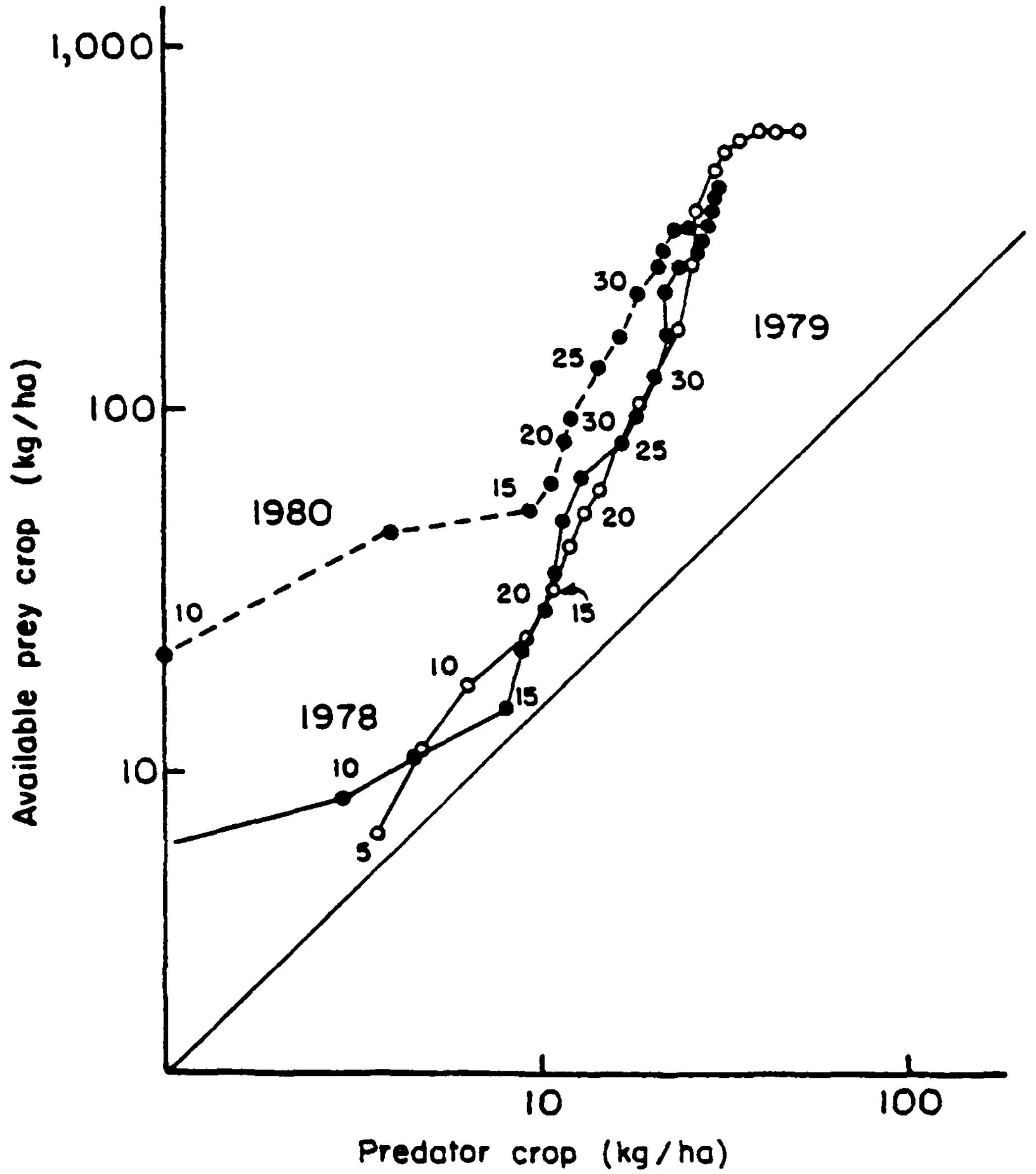

Figure 31. Available prey-predator relationship (AP/P) based on cove rotenone samples (1978-1980), West Point Lake, Alabama-Georgia. Points are centimeter groups of bass equivalents.

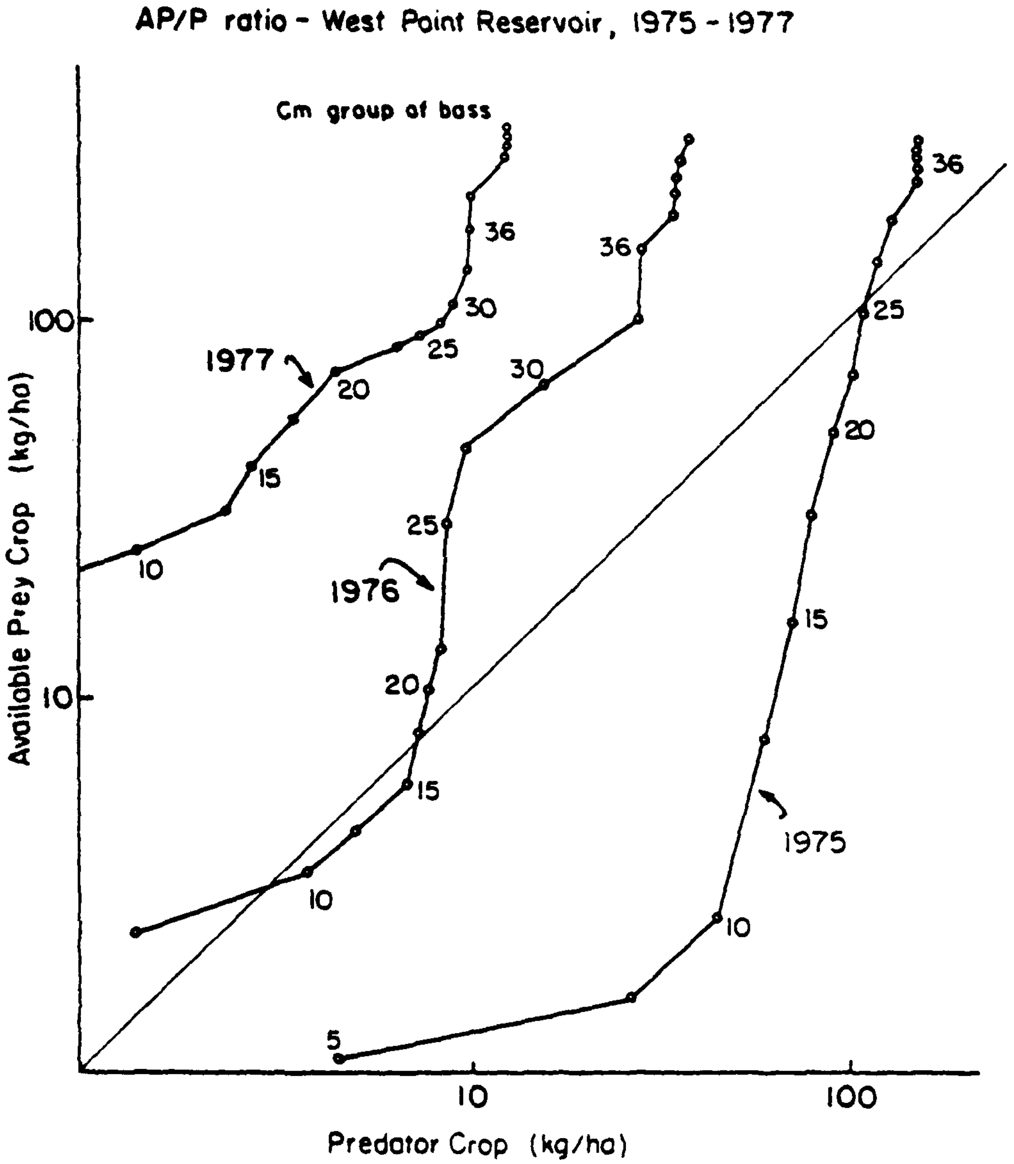

Figure 32. Available prey-predator relationship (AP/P) based on cove rotenone samples (1975-1977), West Point Lake, Alabama-Georgia. Points are centimeter groups of bass equivalents.

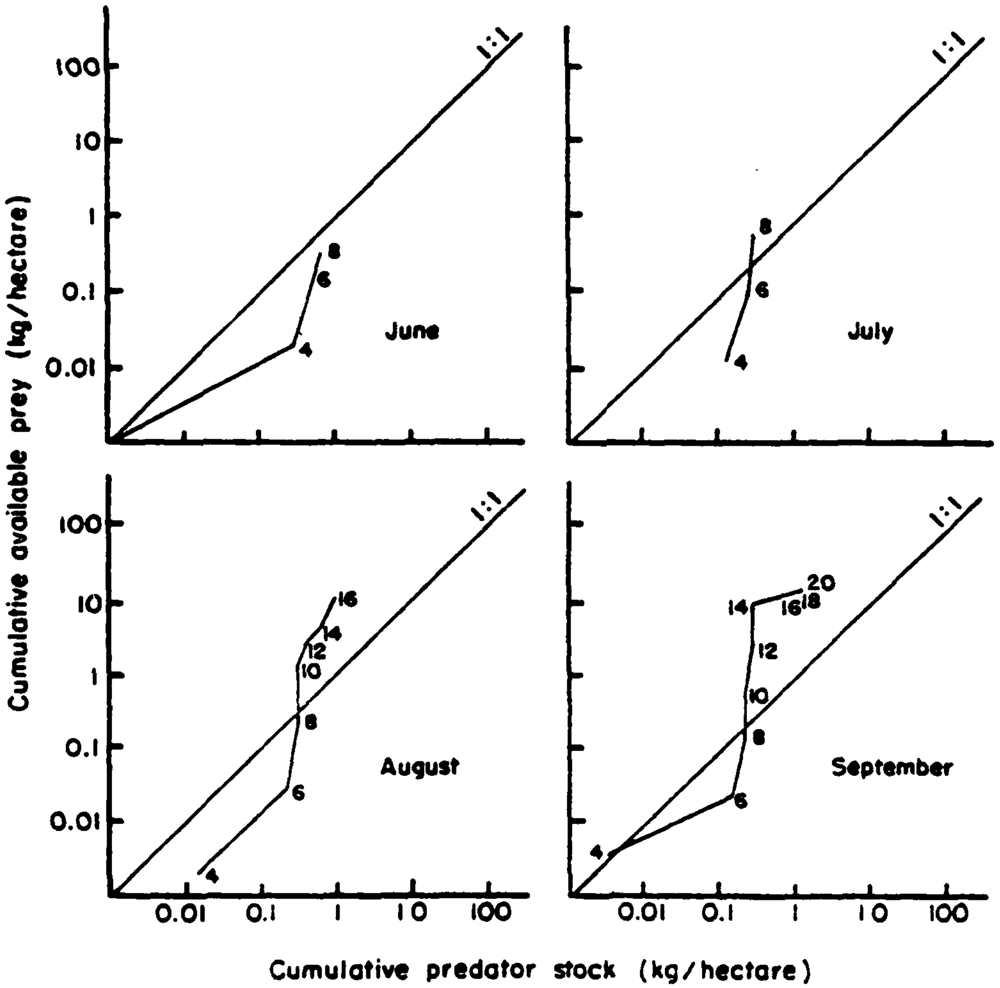

Figure 33. AP/P ratios based on littoral rotenone sampling, West Point Lake, Alabama-Georgia (1980). Numbers are total length (cm-groups).

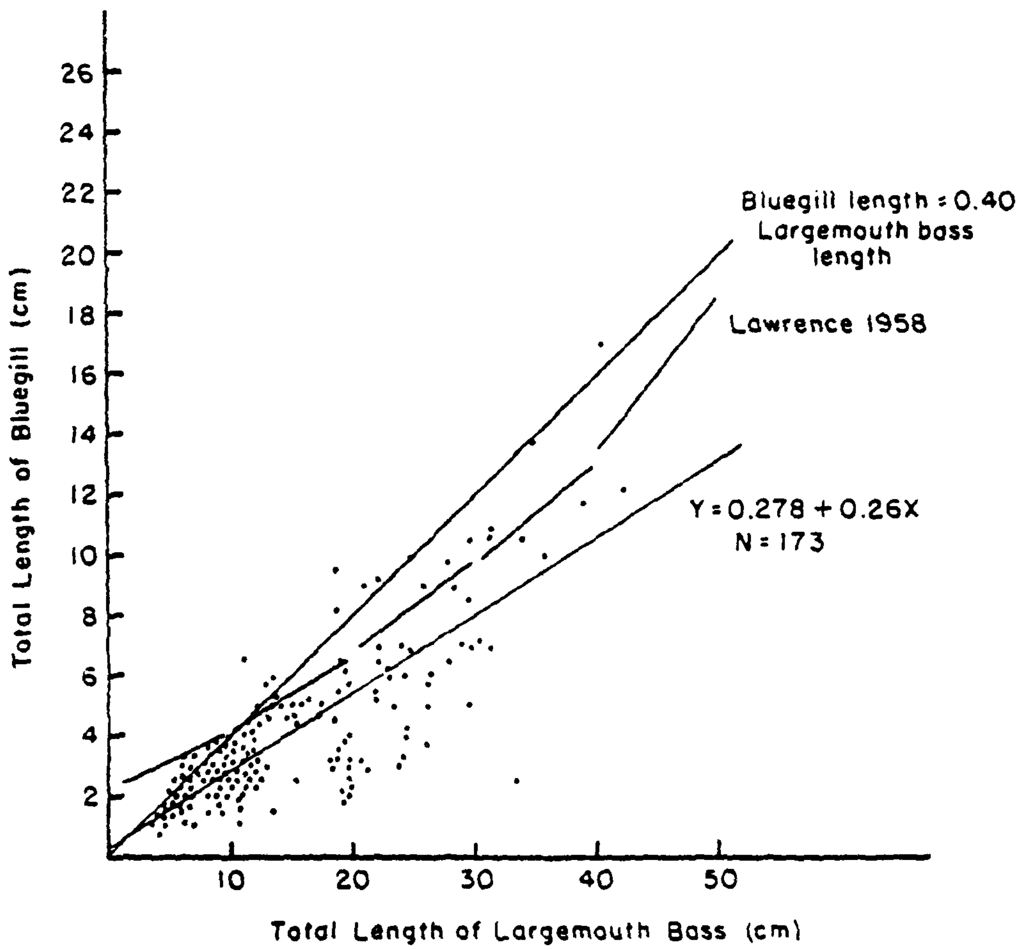

Figure 34. Total length of bluegills from stomachs of largemouth bass from West Point Lake, Alabama-Georgia (1975-1979). Each line is based on different criteria; the lower line is the empirically derived relationship.

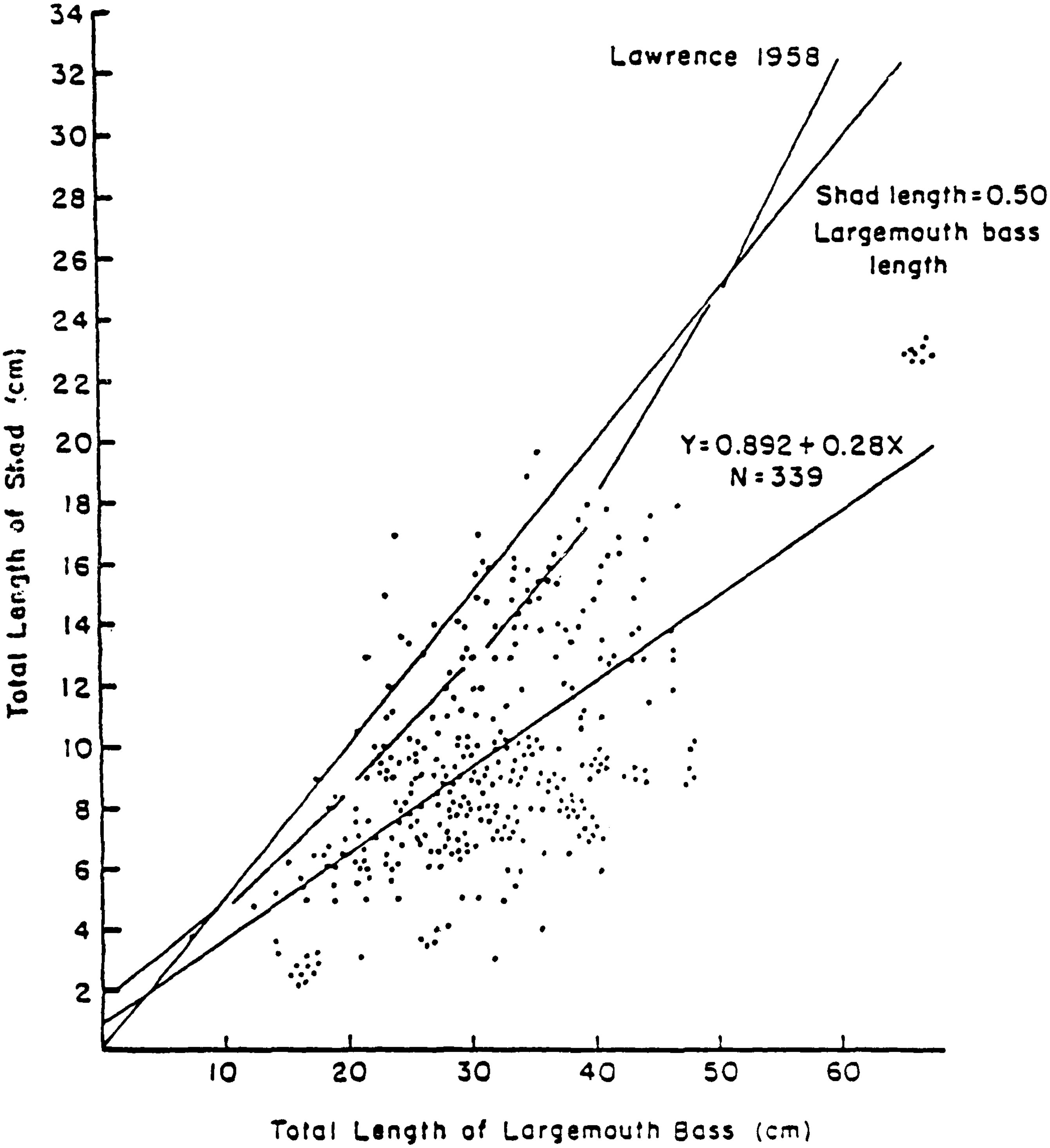

Figure 35. Total length of shad from stomachs of largemouth bass from West Point Lake, Alabama-Georgia (1975-1979). Each line is based on different criteria; the lower line is the empirically derived relationship.

gradually shift to a greater dependence on shad. As shad become an increasingly important component of the diet, bluegill decrease in occurrence. This shift may be a function of size, temporal, or spatial availability; however, the availability of small-sized bluegill may be critical in determining the number of young bass recruited as age I+ fish into the population. This hypothesis is depicted (Fig. 36) as a recruitment-dependent prey relationship that appears to be appropriate for describing the importance of small-sized bluegill as prey for young-of-the-year bass. This model also suggests the imbalance between the abundance of large-sized predators in relation to utilizable-sized prey.

154. The growth, survival and recruitment of Age I+ largemouth bass were described from 466 bass subsampled during 1975-1979 from rotenone (Fig. 37) and electrofishing (Fig. 38) collections. Largemouth bass sampled with rotenone during July-August of each year can be considered a relatively unbiased sample of the size distribution of bass present in the littoral zone. The length-frequency distribution has essentially a single mode and is skewed to the right and emphasizes the relative abundance of age 0 compared to age I+ and older fish in the population.

155. Electrofishing samples taken during the same period, but throughout the year obviously selected for larger fish relative to their abundance in the population. In this respect the length-frequency distribution (Fig. 38) is obviously bimodal. As a result, age and growth studies employing fish collected by electrofishing might reflect a positive bias as those larger (faster growing) individuals would be more frequently sampled.

156. Differences in electrofishing catch rates and population distribution (structure) for largemouth bass between paired day and night samples were evaluated. A total of six paired comparisons per season were made. Seasonal categories are distinguished as being the fall 1979 (October-December), the spring 1980 (February-April) and the summer 1980 (June-August).

157. Statistical analysis, utilizing a paired t test, showed a significant difference (α = .10) between catch rate of largemouth bass captured during the day versus the nighttime for the summer season only, with an increase of 24 bass/sample at night. Changes in population distributions between day and night samples were analyzed with a chi-square test. Largemouth bass exhibited differences (α = .10) for the fall season only (Fig. 39). Differences were due to the disproportional changes in numbers of bass caught within two of the size groups: 20.1-30 cm and greater than 38 cm.

158. The total body length-scale radius relationship was established for each year of collection. These relationships were used to back-calculate lengths of fish collected during each year rather than combine the total data set to calculate a general prediction equation.

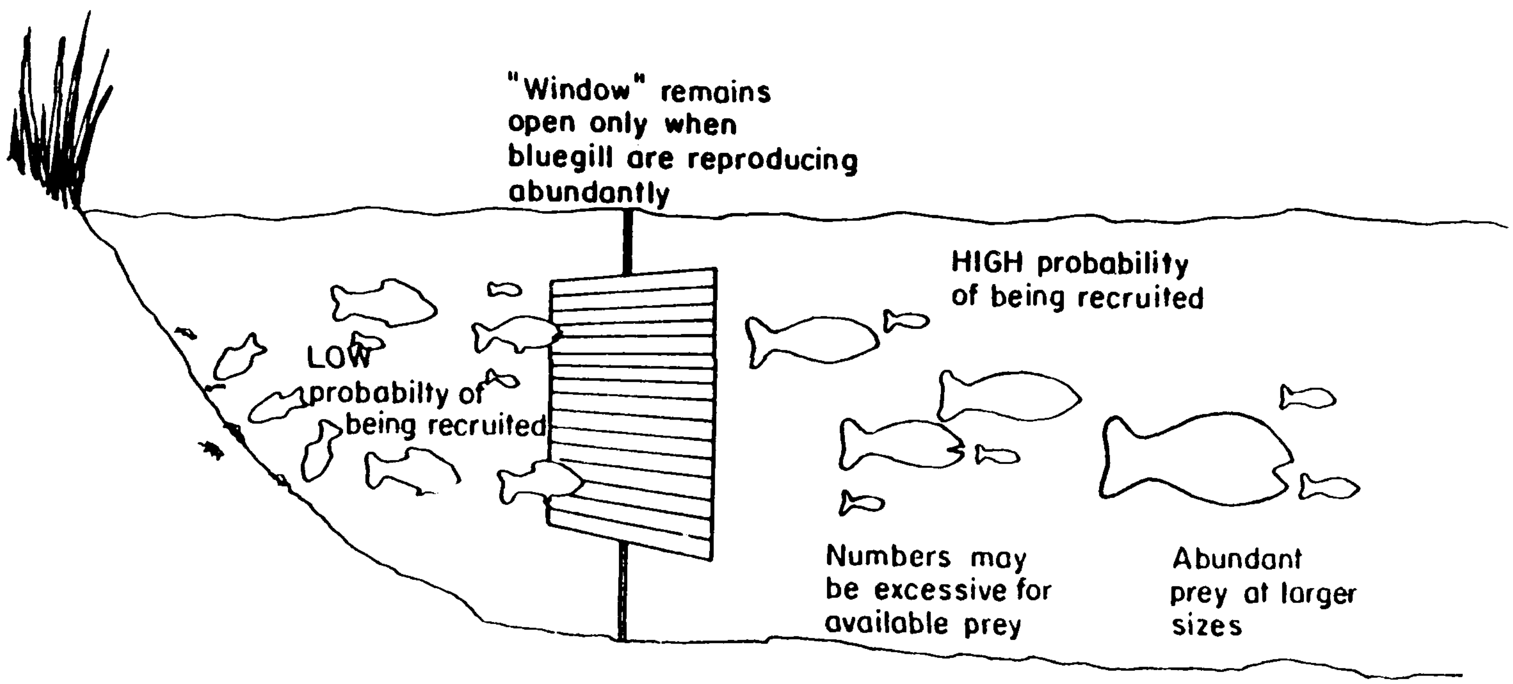

Figure 36. Conceptual model of a recruitment dependent on prey relationship that depicts the importance of small sized prey to young-of-the-year largemouth bass which characterizes conditions in West Point Lake, Alabama-Georgia.

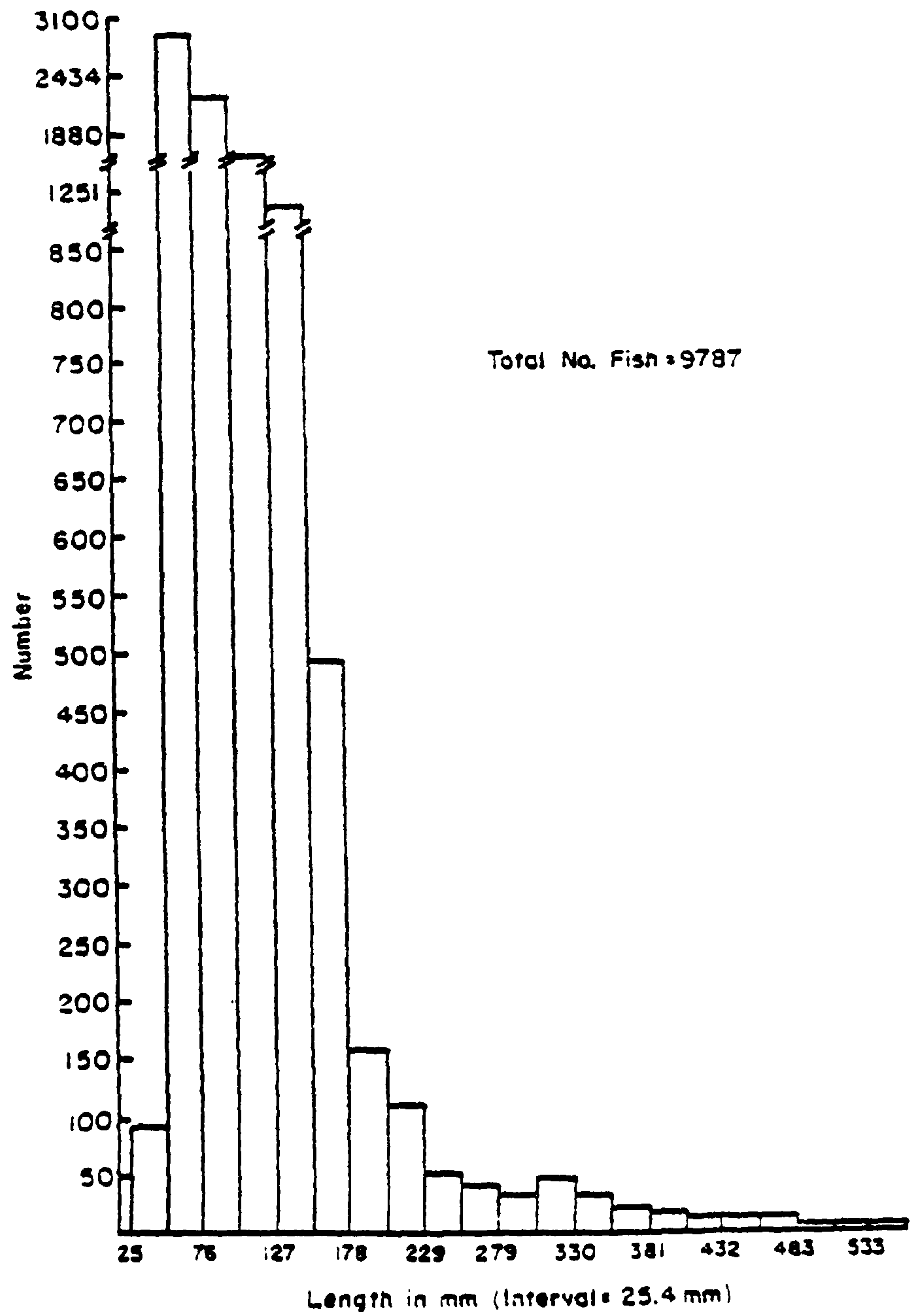

Figure 37. Total length-frequency distribution for the total number of largemouth bass collected with rotenone between 1975 and 1979, West Point Lake, Alabama-Georgia.

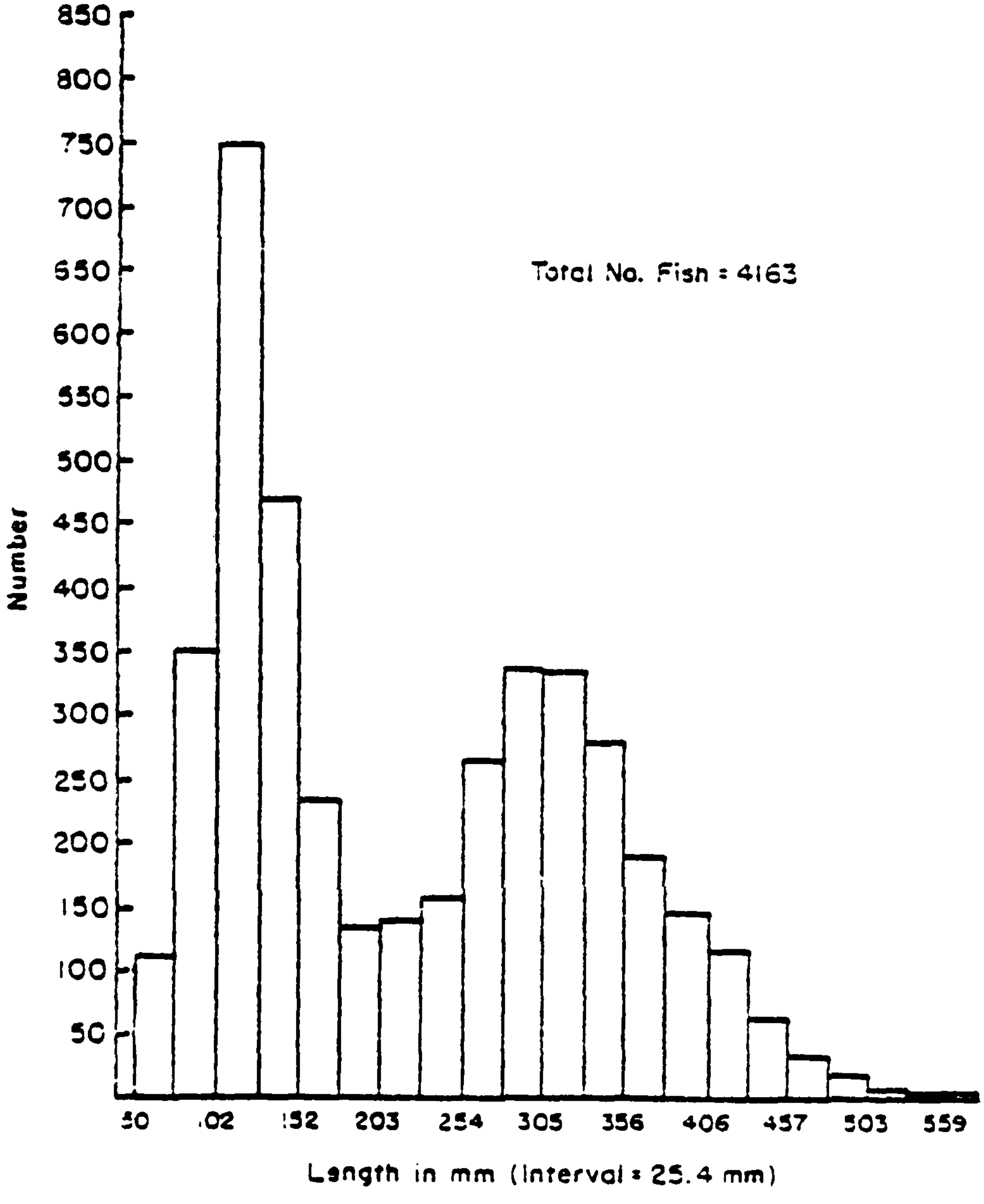

Figure 38. Total length-frequency distribution for the total number of largemouth bass collected by electrofishing between 1975 and 1979, West Point Lake, Alabama-Georgia.

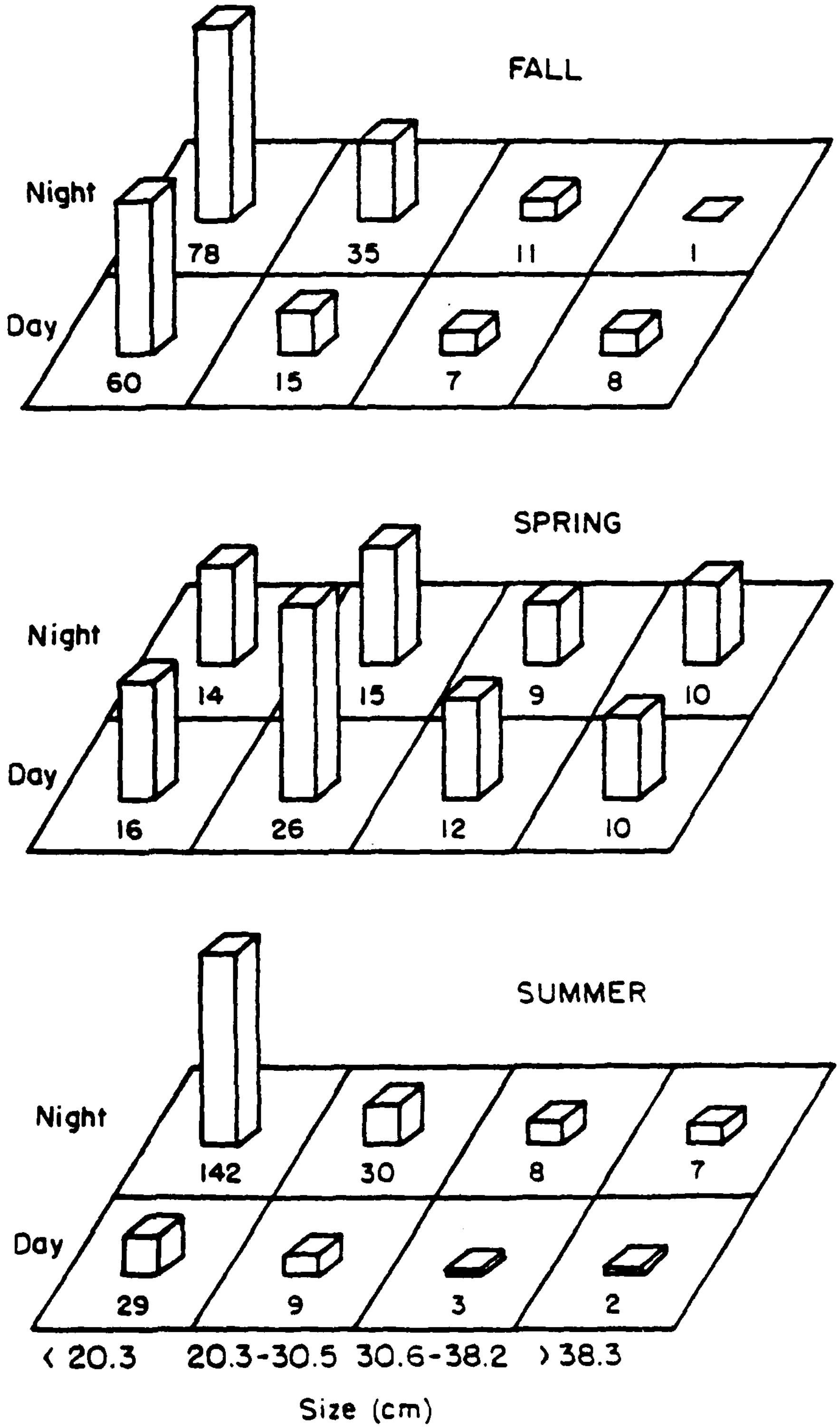

Figure 39. Differences in numbers of largemouth bass in various size groups collected by day and night electrofishing over three seasons at West Point Lake, Alabama-Georgia. Relative heights of polygons are comparable only within seasons.

In each case the relationship accounted for considerable variation in the data set (i.e., R > 68%); also each equation reflected the range of lengths over which lengths at annulus formations were back-calcualted.

159. Scales from 466 fish were examined for annuli; only a relatively few fish (<1%) had scales from which age could not be determined. From previous studies (King et al. 1979), the time of annulus formation was fixed as May-June. For those fish collected early in the year, an annulus was usually assigned to the margin.

160. The length-frequency distribution of back-calculated lengths for year classes 1975 (ages I, II and III), 1976 (ages I, II, and III), 1977 (ages I and II) and 1978 (age I) are depicted in Figure 40. For year classes where two or more age groups are represented there appears to be considerably more variation in back-calculated lengths for ages II and III than for age I. For example, the back-calculated lengths at age II for some fish of the 1975 year class (collected in 1977) are considerably less than back-calculated lengths for those fish of the same year class collected at age I (1976). Very likely those slower growing members of the 1975 year class were not included in the 1976 sample of fish (collected primarily by electrofishing). During 1977, those slower growing members of the 1975 year class (now age II) had reached a size where they were more readily selected by the gear. In this respect, Arias-Arias (1979) demonstrated the selectivity of electrofishing compared to cove rotenone sampling and based on these data, Reed (1980) calculated correction factors to adjust for this bias.

161. The average back-calculated total lengths for each year class (Table 43) are biased in the sense that lengths for age I fish only

Table 43

Growth (TL) at annulus formation by year class, West Point Lake, Alabama-Georgia.

Length at annulus	Year class 1975	1976	1977	1978
I	293.8(1976)*	269.5(1977)*	287.2(1978)*	237.5(1979)*
II	357.7	334.9	336.6	
III	397.1	384.4		

*Year that the Age-I fish were sampled.

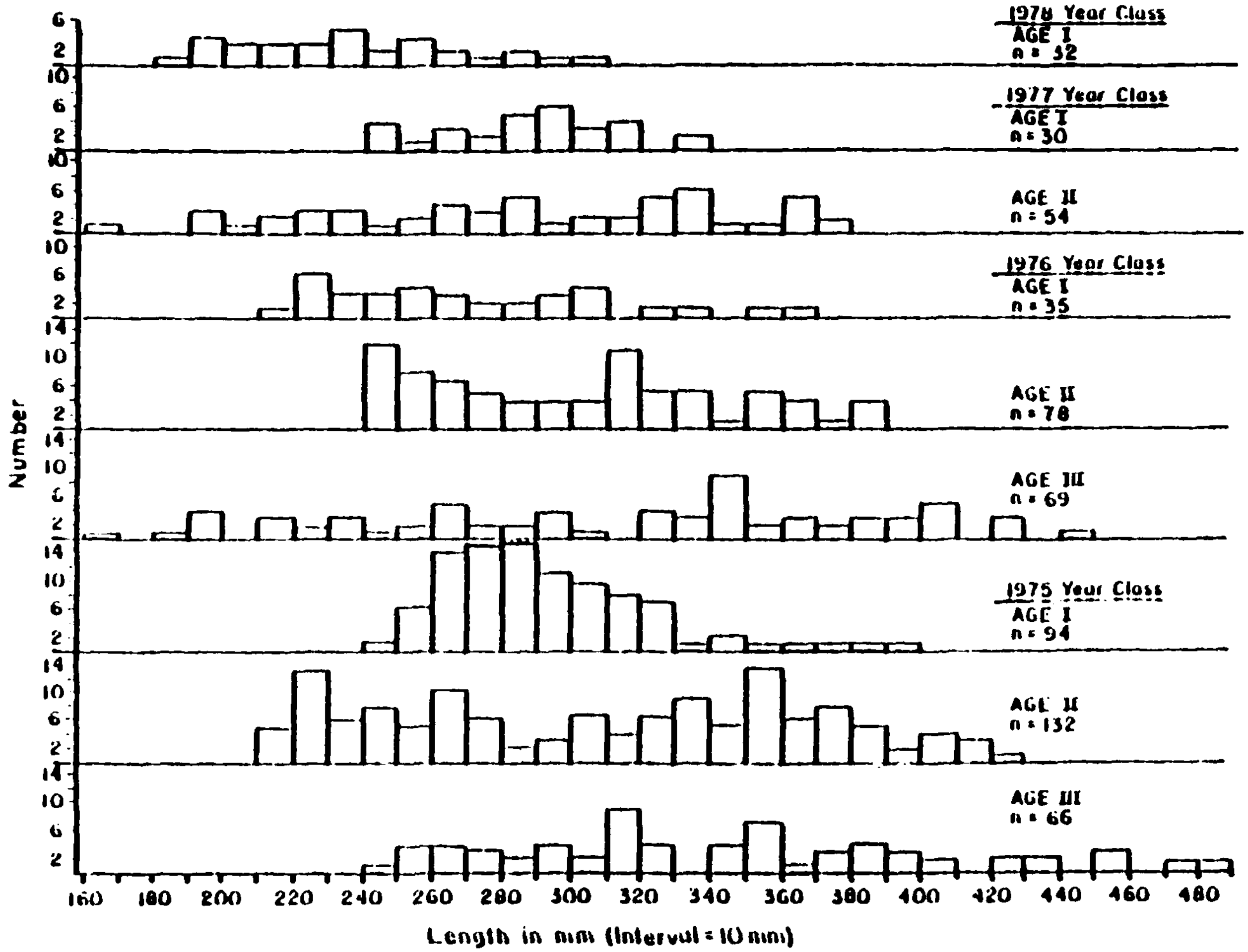

Figure 40. Back-calculated total length-frequency distribution for largemouth bass by age within each year (1975-1978) at West Point Lake, Alabama-Georgia.

represent the growth achieved by the faster growing individuals in the population. Timmons et al. (1980a) discussed the bimodal length distribution of largemouth bass evident each year in West Point Lake and postulated that the scarcity of suitable-size prey may have been the cause. Following the 1977 year class through May-June of 1978, they observed that the faster growing individuals reached a modal length of 280 mm. These fish were just starting their second growing season (age I+); it is encouraging to note that their value corresponds quite closely with the predicted value of 287 mm for age-I fish from the 1977 year class. Average growth in lengths reported for ages II and III may be more representative as slower growing individuals entered the selection range of the gear.

162. The number of fish from the 1975 year class recovered from cove rotenone samples in 1976 through 1979 was 3, 71, 24 and 0. Assuming that sampling effort for the most part was equal between years and that gear efficiency for fish age I+ and older would not bias the results, the calculated annual survival based on these data is 46% (Ricker 1975). Because the second assumption is not entirely valid for reasons previously mentioned, the estimate must be positively biased with the actual rate of survival considerably lower. Of interest is the apparent absence of age-IV fish in the population (e.i., members of the 1975 year class captured during 1979). Obviously, the annual expectation of death is high. Folmar (1980) implied that the expectation of death due to fishing is high and may account for the rapid decline in the number of older fish in the population.

163. The number of bass identified as age I+ in the population each year may be the best estimate of recruitment into the harvestable-size population. Cove rotenone sampling in July-August of each year provides comparable data. Numbers of age I+ fish sampled each year with numbers of young-of-the-year bass sampled the previous year are presented in Table 44 for comparison.

Table 44

Number of largemouth bass per hectare by year class collected from cove rotenone sampling during July-August. Relative number of age I+ fish are compared with number of young-of-the-year collected the previous year.

	Year class			
	1975	1976	1977	1978
No. young-of-the-year per hectare	2,986	330	276	501
No. age I+ present in the following year per hectare	57	10	10	0

164. Only in 1975 does there appear to be any direct relationship between number of young-of-the-year present and age I+ individuals one year later. The initial year class in the reservoir very likely recruited at a higher rate than subsequent year classes because growth and survival were better. At least within broad limits the strength of subsequent year classes produced in the reservoir may not be reflected in the number of bass recruited into the population.

165. An analysis of covariance showed significant differences for adjusted mean lengths and weights between males and females. Because of these differences, a separate length-weight relationship was computed for each sex (Fig. 41). The relative condition factor (Kn) of LeCren (1951) based on predicted average weights for Alabama fishes (Swingle and Shell 1971) is indicated in Table 45 for males and females at different lengths.

Table 45

Relative condition factors of various lengths for male and female largemouth bass, West Point Lake, Alabama-Georgia.

Total length (mm)	Kn	
	Males	Females
100	1.03	0.77
200	1.09	0.97
300	1.13	1.10
400	1.15	1.21
500	1.17	1.30

166. It appears that largemouth bass in West Point Lake have better than average condition at the lengths indicated. In this respect, prey items for larger fish do not seem to be limiting. However, the condition of young-of-the-year (age-0 fish) may be less than adequate as indicated by condition indices calculated from fish collected from littoral rotenone samples (Fig. 42).

Harvest

167. Angler harvest as measured by a roving creel of largemouth bass, black crappie and bream (bluegill, redbreast, redear and green sunfishes) plus bank and boat fishing effort over the past 5 years are given in Figure 43. General trends in harvest and effort from 1976-1979 were discussed by Shelton et al. (1981); discussion here will emphasize changes which occurred in 1980 (February-August only).

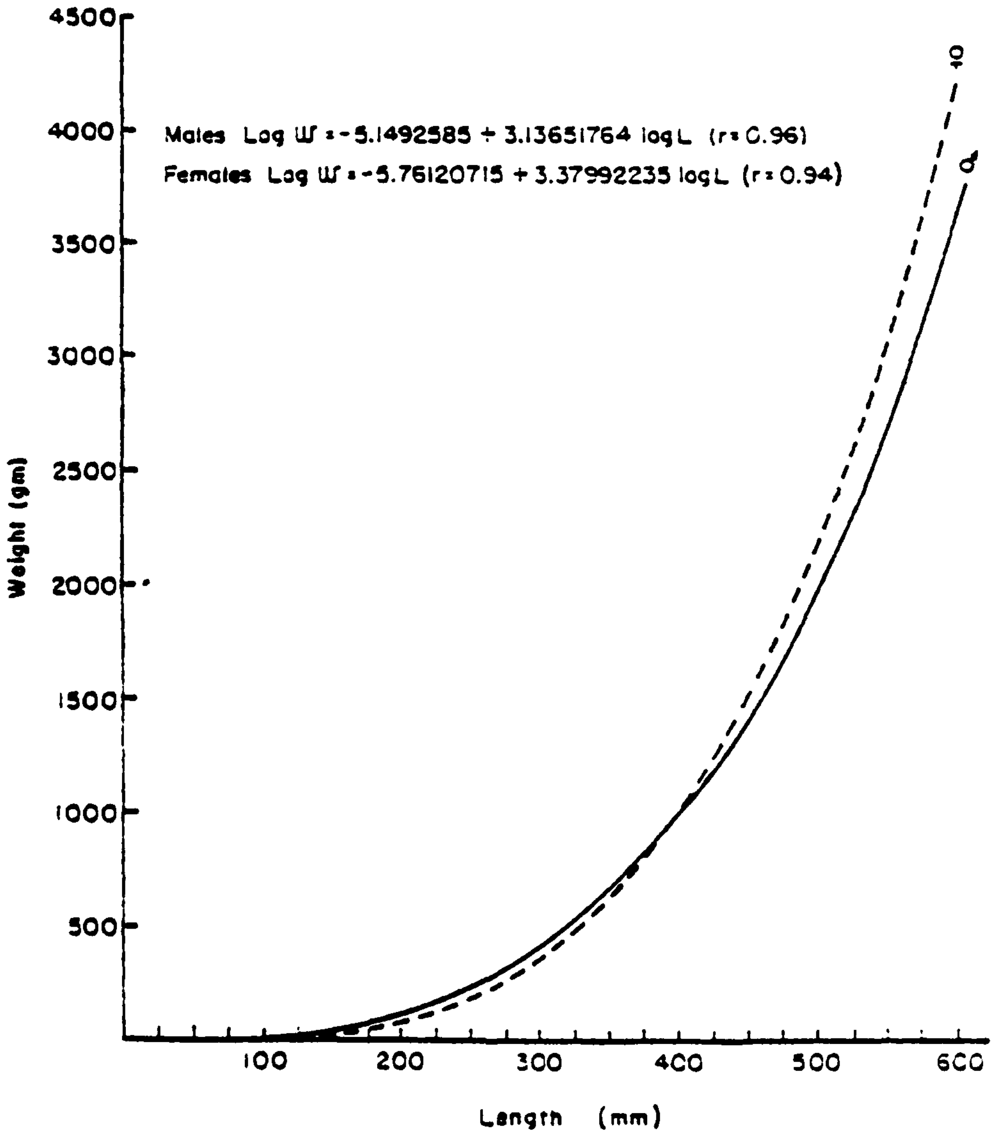

Figure 41. Length-weight relationship for male and female largemouth bass, West Point Lake, Alabama-Georgia, based on fish greater than 100 mm.

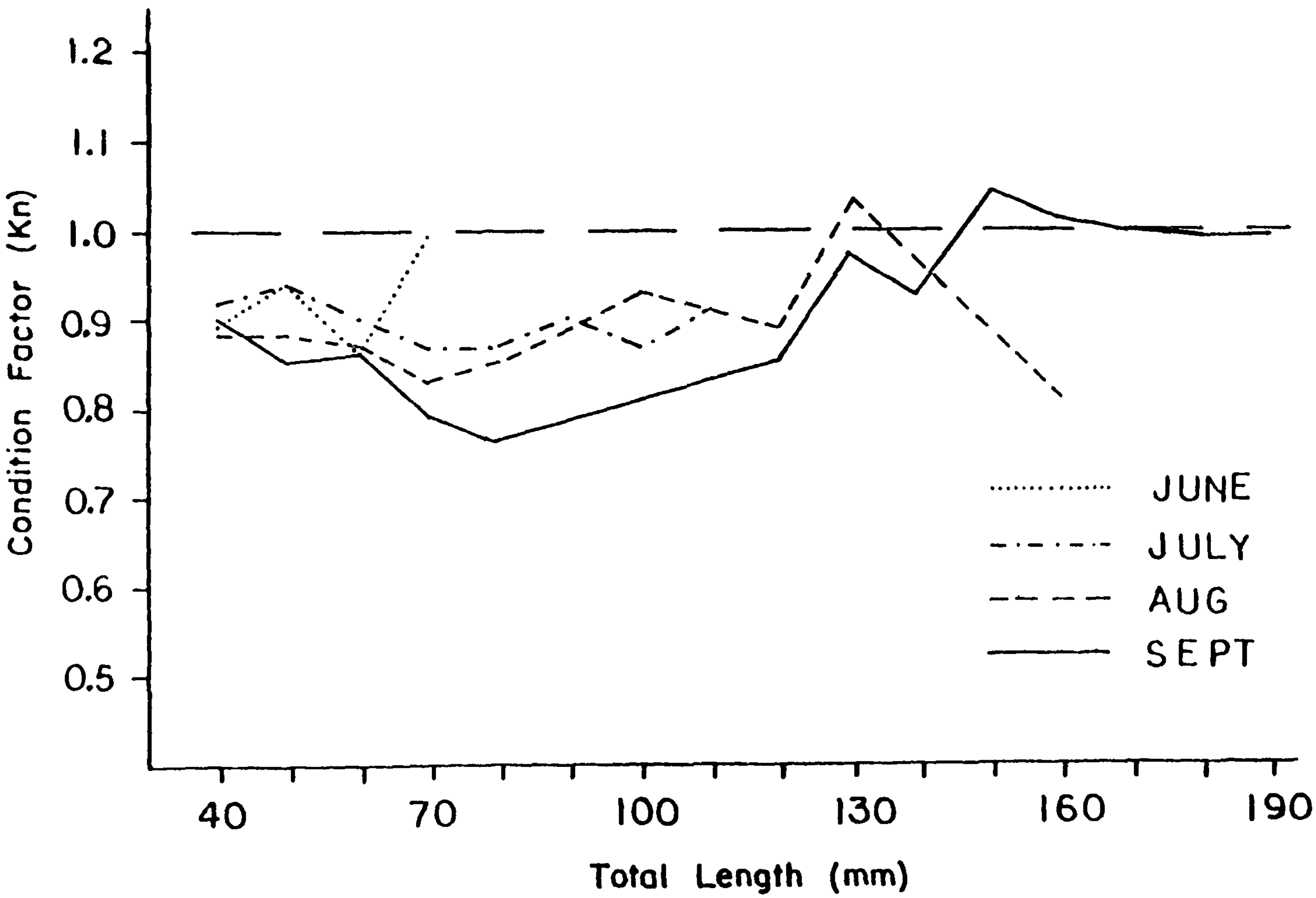

Figure 42. Condition (Kn) of young-of-the-year largemouth bass (June-September 1980) from West Point Lake, Alabama-Georgia.

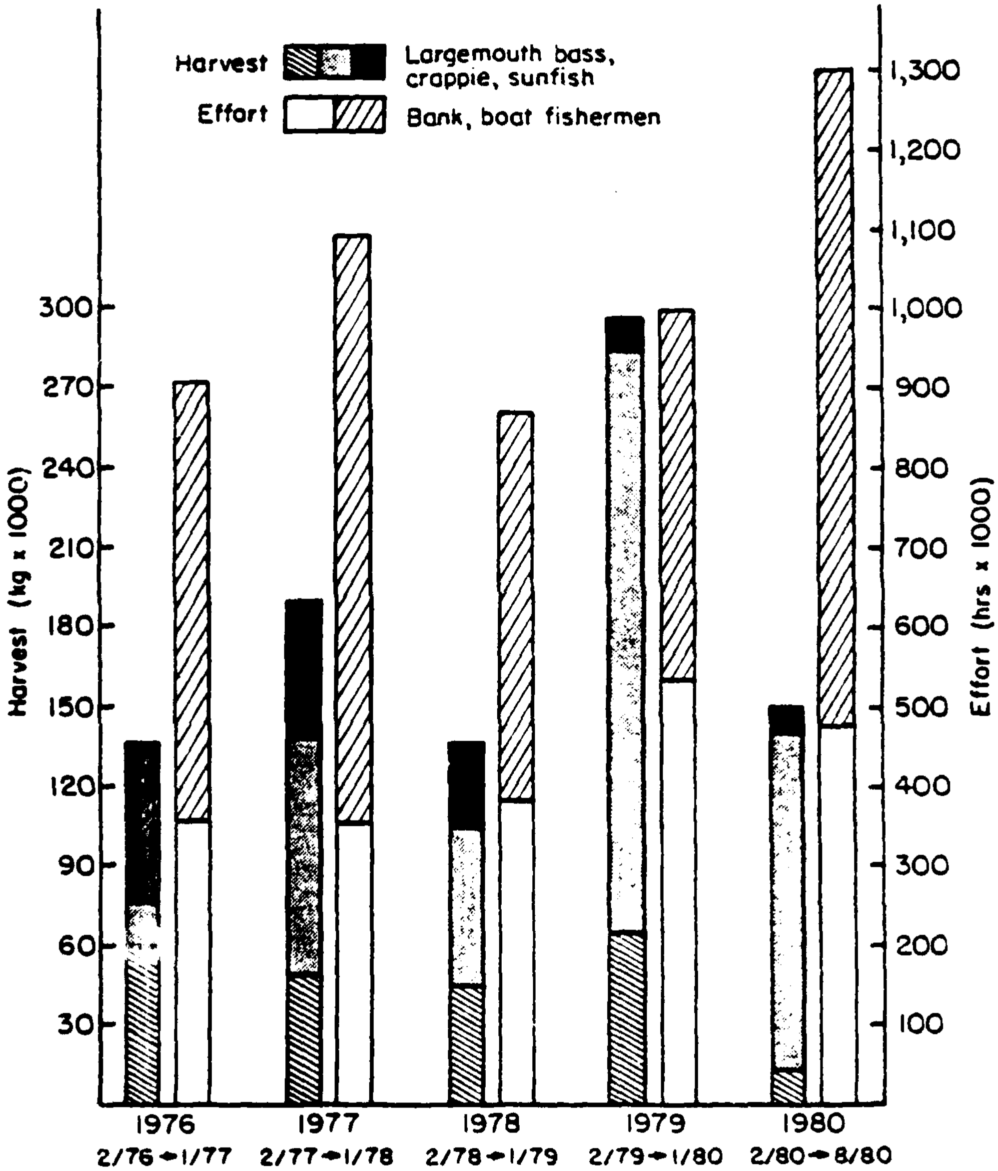

Figure 43. Estimated sportfish harvest (Kg) and effort (hr) for West Point Lake, Alabama-Georgia (1976-1980).

168. It is apparent from Figure 43 that even with only 7 months of 1980 accounted for, total fishing effort reached a new high of about 1,300,000 hours or 122 hr/ha (up from 107 hr/ha during the same period in 1979). Bank fishing effort remained relatively constant. The main contribution to the 1980 increase was boat fishing effort, 76 hr/ha as compared to 40 hr/ha during the same period in 1979. Contrary to a noticeable trend of decreasing boat fishing effort from 1977-1979, this component has rebounded remarkably in 1980.

169. Increased fishing effort in 1980 brought about a 27% increase in angler harvest over the same period in 1979 (from 28 kg/ha to 35.5 kg/ha) and the ratio of harvest to effort also increased slightly from 1979 levels (0.28 kg/hr). Harvest of largemouth bass, black crappie and bream all increased, with the bream harvest showing the largest increase over 1979 levels (44.0%). As in 1979 black crappie made up the largest portion of the total harvest representing 73% of the harvest of the three species groups considered here. Roving creel survey estimates of angler harvest and fishing effort for September 1979-August 1980 on West Point Lake are given in Table 46.

Table 46

Roving creel survey harvest and effort estimates for West Point Lake, Alabama-Georgia, September 1979-August 1980.

	Weight of species harvested (kg)			Effort (fisherman-hours)	
	Largemouth bass	Black crappie	Bream	Bank	Boat
Sept	9,464	4,146	304	33,521	47,957
Oct	2,736	3,415	284	7,130	35,783
Nov-Jan	4,382	22,124	552	30,117	53,084
Feb	406	42,443	0	19,146	40,046
Mar	0	5,562	399	31,992	20,689
Apr	28,125	166,907	4,549	320,970	420,171
May	28,087	16,207	7,345	61,031	204,891
Jun	2,300	1,998	970	13,947	43,944
Jul	2,160	39	2,409	23,242	51,639
Aug	1,833	509	1,208	13,314	18,860
Total	74,493	263,350	18,020	554,410	937,064

Harvest Regulations

170. Based on our conceptual model (Fig. 36) recruitment of largemouth bass (age I+) is dependent on the availability of small-sized

prey. In West Point Lake, it is our contention that recruitment is an important factor limiting largemouth bass production. Once largemouth bass are recruited at age I+ their total annual mortality approximates 50%. Data from tagging studies where tags were returned by fishermen (Bayne et al. 1980) indicated that the annual expectation of death due to fishing was directly proportional to fishing effort directed toward bass and ranged from 30 to 40%. Obviously if harvest were restricted, natural mortality would increase somewhat, but total mortality would still be substantially reduced. As a result, age I+ and older bass would accumulate in the system. The benefits derived would be greater predatory pressure on the abundant larger prey (especially gizzard shad) and a greater catch (but not necessarily harvest) rate. These benefits, however, may be offset by other considerations. For example, the value associated with harvest appears to be an important consideration for both bank and boat fishermen. As a result, fishing pressure would undoubtedly drop (at least initially) if harvest were severely restricted, and the subsequent loss in income to the surrounding communities would be an important consideration.

171. Largemouth bass in West Point Lake that are approximately 40 cm in total length weigh about 1 kg and are in their 4th year of life. At this time they are capable of feeding on shad with a total length of approximately 12 cm (Fig. 35). Since most gizzard shad in the system are somewhat larger (length frequencies with modal lengths of 15 to 17 cm in most years), bass should be protected until they reach a larger size. Using the relationship depicted in Figure 35, bass of approximately 50 cm are required for more efficient utilization of the availble prey. Restricting the harvest to those bass greater than 50 cm would undoubtedly result in substantially more bass in the system and better catch rates.

172. Largemouth bass in West Point Lake would (on the average) reach a total length of 50 cm in their 6th year of life and would weigh approximately 2 kg. Even at this time estimates of growth (G) would exceed estimates of natural mortality (M) indicating that bass biomass would still be accumulating in the system. During the time that bass of a larger size are accumulating in the system, harvest rate would be greatly reduced.

Sampling Efficiency

173. Optimal allocations of creel sampling days would imply that the total number of days normally sampled during February-October would be divided between months proportional to the variation in fishing effort expected. Presently, days are allocated equally between months. Monthly variation in fishing effort can be predicted using historical temperature and rainfall data (Malvestuto et al. 1979). The resulting allocation of sampling effort would allow those summer months which exhibit more variability to be sampled most intensively, and should increase the precision of the survey.

CONCLUSIONS

174. In large impoundments, fish production, measured in terms of yield of sport fishes, usually declines after reaching a peak during the early years of impoundment (3-8 years). If, through management, this peak could be maintained or the decline in yield attenuated, a fuller utilization of the resource could be realized. The causes of this "boom and bust" sequence is a major question of the 10-year study on West Point Lake.

175. There are basically two explanations for the "boom and bust" phenomenon. One deals with the dynamics of expanding fish populations and the other with variations in primary productivity of the system. The flooding of a new reservoir provides a vast amount of unoccupied space. As resident river fishes spawn, abundant young prey species are available to support large numbers of young carnivorous sport species resulting in high yields of sport fishes in the early years. Gradually more and more of the fish biomass is composed of larger adult prey species that are not available to sport fishes as food; production and yield of sport fishes subsequently declines. The other explanation, referred to as the "new land effect," proposes that the leaching of nutrients from rich flood plain soils and decomposition of inundated organic matter result in initially high primary productivity (formation of new organic matter by plankton algae). With time these fertile conditions pass, primary productivity declines and a decrease in sport fish yield results.

176. Fishery and limnological studies of West Point Lake during four early years (1976-1979) have yielded data on water quality, primary productivity, phytoplankton standing crop, fish standing crop and sport fish yield. Results to date indicate that the lake is mesotrophic (moderately productive) and, when compared to other southeastern reservoirs, the waters of West Point Lake produce high standing crops of fish (Tables 47 and 48). Among several similar reservoirs of the Southeast with comparable data available, West Point ranks only fifth in primary productivity, but first in fish standing crop (Table 48). There seems to be an efficient transfer of organic materials through the food web resulting in relatively high fish biomass (391 kg/ha).

177. The annual productivity values for West Point Lake shown in Tables 47, 48 and 49 as well as Figure 44 were derived from averages of four successive quarters beginning with the June 1976 sample and extending through 1979. This method of reporting primary productivity was chosen for a paper to be published at a later date (Bayne, personal communication[1]) so means differ from reporting periods used for West

[1] David R. Bayne, Associate Professor, Department of Fisheries and Allied Aquacultures, Auburn University, Alabama.

Table 47

Trophic relationships of three southeastern reservoirs.

	Mean net primary productivity (mg C/m^2/day)	Chlorophyll a (µg/l)	Total carbon (mg/l)	Total organic carbon (mg/l)	Total P[a] (µg/l)	Total N[b] (µg/l)
Trophic Type[c]						
Oligotrophic	50–300	0.3–3	--	1–3	1–5	1–250
Mesotrophic	250–1,000	2–15	--	1–5	5–30	250–1,100
Eutrophic	1,000	10–500	--	5–30	30–5,000	500–15,000
Reservoir						
Walter F. George[d]	--	9	11–17	--	34–65	700–930
West Point	[illegible]	10	8.5	--	270	1,167
Beech[e]	1,619	12	--	5.8	--	800

[a] Includes ortho P + particulate P.
[b] Inorganic N.
[c] Wetzel, R. G., 1975.
[d] Lawrence, J. M., 1974.
[e] Taylor, M. P., 1972.

Point Lake annual reports. Estimated annual mean primary productivity has increased (Figure 44) during the initial years. Fish standing crop during this time has also remained high (Table 49). The variation in yield of sport fishes (Table 49) that has been observed thus far is apparently due to factors inherent in the fish community structure and not due to variations in fertility or production of organic matter within the lake. These findings, though tentative, are encouraging in that sport fish yield should respond to proper management of the fishery. Decline in harvest due to decreased productivity would be much more difficult to reverse.

Table 48

Relationship of fish biomass to phytoplankton productivity (based on rotenone samples) in some southeastern reservoirs.

Reservoir	Fish standing crop Rank	kg/ha	Years sampled	Phytoplankton productivity Rank	mg $C/m^2/day$
West Point[1]	1	391	1976-79	5	684
Walter F. George[2]	2	382	1963-67	--	--
Kentucky[3]	3	280	1952, 63, 64	2	1,443
Cherokee[3]	4	230	1963	3	1,416
Norris	5	150	1941, 60, 61	6	360
Nottely[3]	6	143	1961, 64, 65	7	208
Douglas[3]	7	125	1961, 65	4	943
Beech[3]	--	--	--	1	1,619

[1]Excluding one 1977 cove sample in which over a ton of shad per hectare were recovered.
[2]Lawrence, J. M. 1974.
[3]Taylor, M. P. 1971b.

Table 49

Estimated primary productivity, fish standing crop and sport fish yield (harvest) during the first four sampling years following impoundment of West Point Lake.

Sampling Year	Primary Productivity ($mg\ C/m^2/day$)	Fish Standing Crop (kg/ha)	Yield to Fishermen (metric tons)		
			Bass	Crappie	Bream
1976	550	364	50	74	59
1977	731	294	55	56	30
1978	692	285	64	212	15
1979	763	597	38	159	10

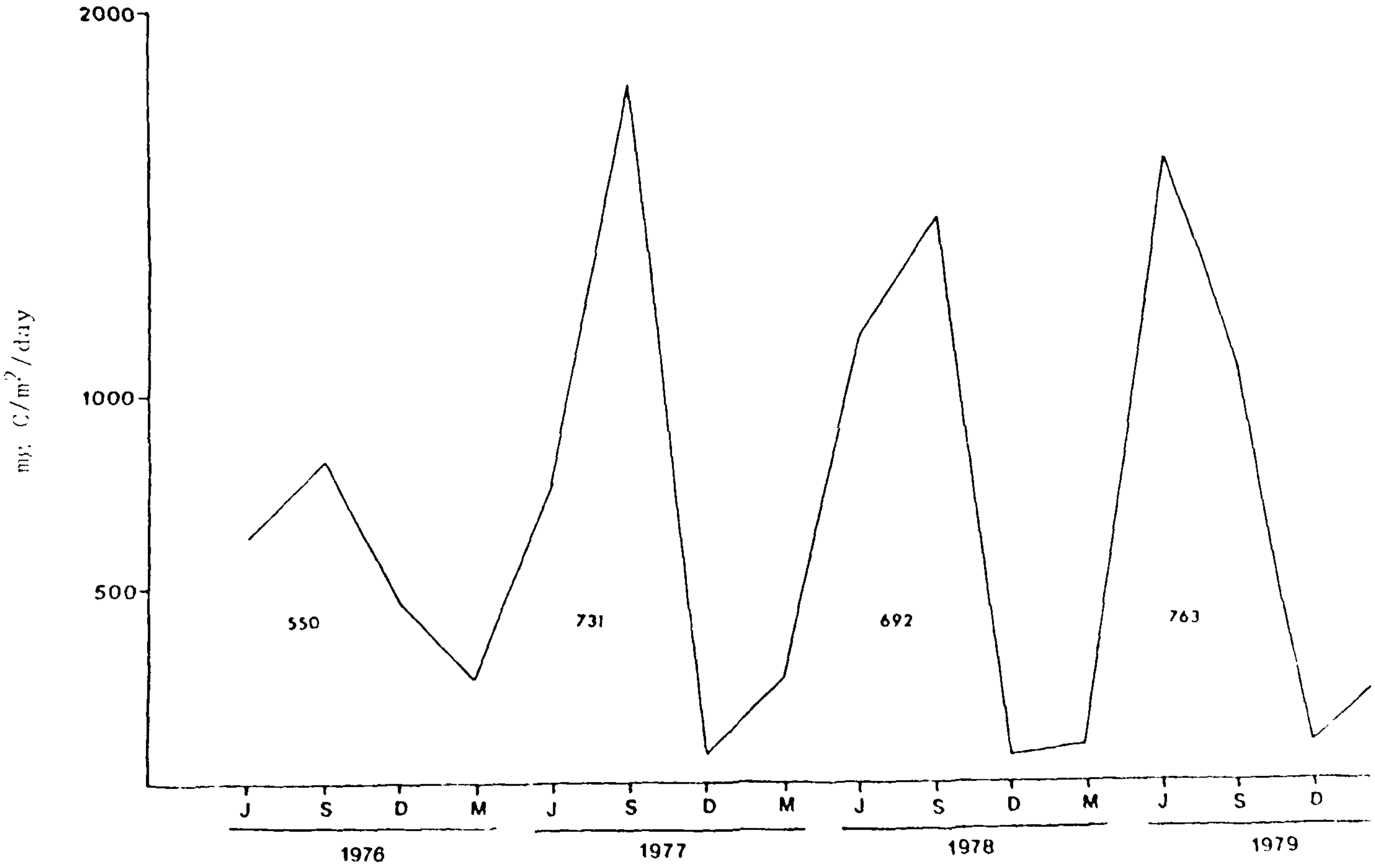

Figure 44. Estimated net primary productivity (mg C/m^2/day) of the phytoplankton of West Point Lake during each quarter (June, September, December and March) of the first four years following impoundment. The number appearing under the curve represents the annual mean primary productivity for each year.

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APPENDICES

APPENDIX A

Table 1

Hydrological and meteorological data for West Point Reservoir study, October 1979-September 1980.

Year	Month	Mean Daily Inflow[1] (cfs)	Mean Daily Discharge[2] (cfs)	Lake Elevation[2] (msl)	Total Rainfall[3] (inches)	Solar Radiation[4] (Langleys)
1979	October	3,495	4,660	635.1	1.81	9,541
	November	4,229	7,482	632.2	5.64	5,370
	December	2,725	3,935	626.8	1.29	5,142
1980	January	6,211	6,353	628.2	4.52	4,194
	February	4,715	7,340	628.7	3.60	7,153
	March	12,170	14,289	630.1	13.87	9,008
	April	10,120	11,789	634.3	4.99	13,564
	May	7,491	9,772	636.0	6.70	13,955
	June	4,207	4,824	636.3	3.51	17,274
	July	3,169	4,079	635.6	1.01	16,568
	August	2,972	5,141	631.7	1.32	14,594
	September	2,852	4,242	625.8	2.63	11,658

[1] Inflow USGS Gaging Station, Whitesburg, Georgia.

[2] Lake levels and discharge Powerhouse of West Point Reservoir.

[3] Rainfall accumulations NOAA, National Weather Station, LaGrange, Georgia.

[4] Continuous Solar Radiation NOAA, National Weather Service Station, Auburn, Alabama.

APPENDIX A

Table 2

Turbidities (JTU's) of West Point Lake waters at indicated stations and depths for sampling periods from 17 October 1979 to 4 September 1980.

Sta.	Depth, m	17 Oct 79	5 Dec 79	12 Feb 80	19 Mar 80	9 May 80	5 Jun 80	5 Aug 80	26 Aug 80	4 Sep 80
A	0	21.0	20.0	38.0	74.0	13.0	13.0	15.0	16.0	17.0
	2	30.0	19.0	37.0	78.0	14.0	17.0	15.5	--	21.0
B	0	12.0	11.0	46.0	49.0	7.6	3.5	3.6	5.6	6.8
	2	11.0	11.0	47.0	48.0	8.1	6.2	4.3	7.9	7.8
	4	11.5	11.0	45.0	53.0	7.4	12.0	8.9	10.5	11.0
	8	15.0	11.0	--	54.0	7.4	19.0	20.5	18.0	10.5
	12	19.0	27.0	--	54.0	7.1	19.5	21.5	16.0	16.0
C	0	3.5	17.0	14.0	59.0	2.3	3.7	3.9	3.5	3.5
	2	3.4	18.0	13.0	57.0	2.4	4.1	3.4	2.9	3.6
	4	3.5	17.0	14.0	58.0	1.9	11.0	3.3	2.5	3.4
	8	3.5	16.0	14.0	56.0	4.3	23.0	6.3	4.6	3.3
	16	3.2	--	15.0	58.0	9.9	24.5	33.0	8.9	23.0
D	0	1.1	4.2	14.0	64.0	2.3	1.5	1.3	3.0	4.0
	2	1.3	4.3	13.0	66.0	2.5	1.8	1.3	2.7	3.4
	4	1.4	4.0	12.0	64.0	2.3	1.8	1.2	2.7	3.6
	8	1.4	5.0	12.0	63.0	2.6	17.0	1.1	2.1	1.4
	16	2.3	5.6	13.0	62.0	10.0	24.0	9.7	17.0	16.5
	24	16.0	6.6	31.0	64.0	15.0	15.0	13.0	10.5	25.0
E	0	2.1	8.6	14.0	79.0	5.5	14.0	4.5	13.0	4.3
F	0	2.5	7.5	19.0	47.0	3.0	4.1	1.6	2.4	3.6
	2	2.7	7.4	19.0	45.0	3.6	5.9	1.7	3.1	3.7
	4	4.3	8.2	20.0	44.0	4.3	15.0	2.0	3.7	3.8
G	0	1.9	7.4	6.5	74.0	2.0	2.0	1.4	2.9	3.2
	2	2.5	7.5	6.4	75.0	2.0	1.6	1.6	2.7	3.1
	4	2.9	8.4	6.1	74.0	2.3	9.0	2.4	2.2	3.2

APPENDIX A

Table 3

Temperatures (°C) of West Point Lake waters at indicated stations and depths for sampling periods from 17 October 1979 to 4 September 1980.

Sta.	Depth, m	17 Oct 79	5 Dec 79	12 Feb 80	19 Mar 80	9 May 80	5 Jun 80	5 Aug 80	26 Aug 80	4 Sep 80
A	0	15.0	--	--	11.0	19.0	29.0	29.0	--	--
	2	15.0	--	--	11.0	19.0	27.0	29.0	--	--
B	0	17.5	14.2	--	11.0	21.8	29.0	31.5	27.5	28.5
	2	16.5	13.8	--	11.0	20.4	27.0	32.0	27.0	27.0
	4	16.5	13.4	--	10.0	19.8	25.0	29.5	25.5	26.0
	8	16.5	12.4	-	10.0	19.6	21.5	28.5	25.5	25.0
	12	16.5	12.8	--	10.0	17.0	21.0	28.0	25.0	24.5
C	0	20.2	12.0	6.5	10.0	22.5	29.0	30.0	29.2	29.6
	2	20.2	12.0	6.5	10.0	21.5	28.3	30.0	29.0	29.0
	4	19.6	11.0	6.5	10.0	21.0	25.0	29.5	28.8	29.0
	8	[illegible]	11.0	6.5	9.0	20.0	22.0	28.5	28.7	28.0
	16	19.0	--	6.5	9.0	17.0	20.5	25.5	26.8	26.5
D	0	20.0	13.0	6.5	9.0	22.5	29.5	29.0	29.0	29.5
	2	20.0	12.0	6.5	9.0	21.5	29.0	29.0	29.0	29.7
	4	19.8	12.0	6.5	9.0	21.0	29.0	29.5	29.0	29.0
	8	19.8	11.5	6.5	9.0	20.5	23.0	29.0	29.0	28.5
	16	19.8	12.1	8.0	9.0	20.0	22.5	26.0	27.0	27.0
	24	19.5	12.1	7.0	9.0	17.0	19.0	25.0	26.0	26.5
E	0	21.5	12.0	6.0	9.0	20.5	23.0	27.0	--	--
F	0	21.0	12.0	6.0	9.0	23.5	32.0	30.5	29.2	30.0
	2	20.5	12.0	6.0	9.0	21.0	29.5	29.5	29.0	30.0
	4	19.8	12.0	6.0	9.0	19.3	26.0	29.5	28.8	28.8
G	0	20.0	10.6	--	9.0	22.6	30.5	32.0	29.0	29.5
	2	19.5	10.6	--	9.0	21.5	28.0	30.5	29.0	29.0
	4	19.9	10.4	--	9.0	21.5	23.5	30.0	29.0	29.0

APPENDIX A

Table 4

Mean phytoplankton densities (organisms/ml) reported by algal division at each station and date for the 1979-80 sampling year at West Point Lake. Values are means of counts made at all depths at each station.

Date	Algal Division	Station A	B	C	D	E	F	G
		Organisms/ml						
17 Oct 79	Chrysophyta	688	1078	1106	625	757	1442	1078
	Chlorophyta	91	297	994	658	810	285	1361
	Cyanophyta	21	45	59	87	105	25	39
	Others	50	15	138	67	106	196	104
	Total	850	1435	2297	1437	1778	1948	2582
12 Feb 80	Chrysophyta	106	145	555	268	275	147	1190
	Chlorophyta	68	39	359	50	43	27	150
	Cyanophyta	5	2	5	6	6	18	4
	Others	2	2	21	88	40	7	79
	Total	181	188	940	412	364	199	1423
9 May 80	Chrysophyta	251	572	323	682	145	835	338
	Chlorophyta	52	598	454	335	114	310	268
	Cyanophyta	9	97	460	1693	509	54	470
	Others	3	32	16	77	43	302	19
	Total	315	1299	1253	2787	811	1501	1095
5 Aug 80	Chrysophyta	495	797	1098	2968	1681	992	1346
	Chlorophyta	115	1561	1378	568	180	568	774
	Cyanophyta	11	199	367	100	220	266	128
	Others	11	54	124	62	60	128	75
	Total	632	2611	2967	3698	2141	1954	2323

APPENDIX A

Table 5

Mean zooplankton densities (organisms/l) by station and date for 1979-80. Immature copepods are included in these counts.

Date	Zooplankton Group	Station A	B	C	D	E	F	G
		Organisms/l						
17 Oct 79	Rotatoria	4.0	155.3	401.0	248.8	287.0	366.7	466.0
	Copepoda	0.4	4.0	9.8	67.7	98.0	36.2	17.6
	Cladocera	0.1	3.9	0.9	8.8	13.9	4.1	0.9
	Others	0.1	0.1	0.0	0.0	1.8	0.0	0.4
	Total	4.6	163.3	411.7	325.3	400.7	407.0	484.9
12 Feb 80	Rotatoria	9.5	17.0	16.3	30.3	35.0	15.7	66.3
	Copepoda	3.1	4.2	8.0	14.8	20.8	9.3	12.6
	Cladocera	0.4	0.7	0.9	1.3	0.1	1.7	0.2
	Others	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	13.0	21.9	25.2	46.4	55.9	26.7	79.1
9 May 80	Rotatoria	2.0	19.7	608.3	542.5	143.0	124.3	456.3
	Copepoda	0.7	3.9	10.4	55.0	27.4	133.1	34.7
	Cladocera	0.1	0.7	8.5	85.9	50.4	16.1	46.7
	Others	0.1	0.0	0.0	0.0	0.0	1.5	0.7
	Total	2.9	24.3	627.2	683.4	220.8	275.0	538.4
5 Aug 80	Rotatoria	1.0	33.0	20.3	10.5	1.0	17.0	16.0
	Copepoda	0.3	2.2	4.4	1.6	0.9	7.9	7.0
	Cladocera	0.2	0.5	0.5	0.4	0.1	2.3	0.9
	Others	0.2	0.0	0.0	0.0	0.2	0.0	0.0
	Total	1.7	35.7	25.2	12.5	2.0	27.2	23.9

APPENDIX A

Table 6

Check-List of Fishes of West Point Reservoir and Immediate Watershed.

Petromyzontidae		
1.	Ichthyomyzon gagei	Southern brook lamprey
Lepisosteidae		
2.	Lepisosteus osseus	Longnose gar
Amiidae		
3.	Amia calva	Bowfin
Clupeidae		
4.	Dorosoma cepedianum	Gizzard shad
5.	D. petenense	Threadfin shad
Esocidae		
6.	Esox americanus	Redfin pickerel
7.	Esox niger	Chain pickerel
Cyprinidae		
8.	Cyprinus carpio	Carp
9.	Carassius auratus	Goldfish
10.	Campostoma anomalum	Stoneroller
11.	Ericymba buccata	Silverjaw minnow
12.	Hybopsis sp. cf. H. winchelli	undescribed chub
13.	Nocomis leptocephalus	Bluehead chub
14.	Notemigonus crysoleucas	Golden shiner
15.	Notropis atrapiculus	Blacktip shiner
16.	N. callitaenia	Bluestripe shiner
17.	N. hypsilepis	Highscale shiner
18.	N. longirostris	Longnose shiner
19.	N. lutrensis	Red shiner
20.	N. texanus	Weed shiner
21.	N. venustus	Blacktail shiner
22.	N. zonistius	Bandfin shiner
23.	Semotilus atromaculatus	Creek chub
24.	Pimephales promelas	Fathead minnow
Catostomidae		
25.	Carpiodes cyprinus	Quillback sucker
26.	Erimyzon oblongus	Creek chubsucker
27.	E. sucetta	Lake chubsucker
28.	Hypentelium etowanum	Alabama hogsucker

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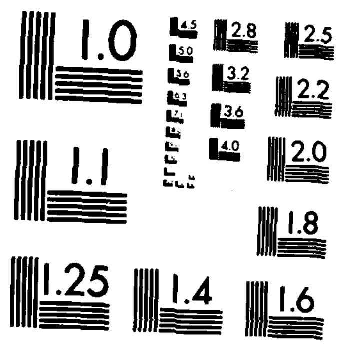

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Table 6. Continued.

29. Minytrema melanops	Spotted sucker
30. Moxostoma sp. cf. M. poecilurum	Undescribed redhorse
31. Moxostoma lachneri	Greater jumprock
Ictaluridae	
32. I. catus	White catfish
33. Ictalurus brunneus	Snail bullhead
34. I. natalis	Yellow bullhead
35. I. nebulosus	Brown bullhead
36. I. punctatus	Channel catfish
37. I. melas	Black bullhead
38. Noturus leptacanthus	Speckled madtom
Cyprinodontidae	
39. Fundulus stellifer	Southern studfish
Poeciliidae	
40. Gambusia affinis	Mosquitofish
Atherinidae	
41. Labidesthes sicculus	Brook silverside
Percichthyidae	
42. Cottus carolinae	Banded sculpin
Centrarchidae	
43. L. marginatus	Dollar sunfish
44. Centrarchus macropterus	Flier
45. L. gulosus	Warmouth
46. Lepomis auritus	Redbreast sunfish
47. L. cyanellus	Green sunfish
48. L. macrochirus	Bluegill
49. L. microlophus	Redear sunfish
50. L. punctatus	Spotted sunfish
51. Micropterus coosae	Redeye bass
52. M. sp. cf. M. coosae	Shoal bass
53. M. punctulatus	Spotted bass
54. M. salmoides	Largemouth bass
55. Pomoxis nigromaculatus	Black crappie
Percidae	
56. Perca flavescens	Yellow perch
57. Percina nigrofasciata	Blackbanded darter
58. Etheostoma fusiforme	Swamp darter
59. Stizostedion vitreum	Walleye
Cottidae	
60. Morone saxatilis x Morone chrysops	Striped bass x White bass

APPENDIX B

Water Quality Data

1. Under separate contractual arrangements with the U.S. Army, Corps of Engineers, Mobile District, the Department of Fisheries and Allied Aquacultures, Auburn University agreed to gather certain chemical data on West Point Lake during the late summer of 1980.

Materials and Methods

2. Water samples for chemical analyses were collected 8 August, 26 August and 24 September 1980 at all stations and depths shown in Figure 1 and Table 2. Chemical variables measured and methods used in the analyses appear in Appendix B, Table 1. When dissolved oxygen concentrations of lake water were <1.0 mg/l as measured with a Y.S.I. polarographic dissolved oxygen meter, water samples were to be collected and processed anerobically in the field. Water samples were to be pumped from the desired depths with an on-board peristaltic pump. The water entered air-tight 1-liter, Nalgene containers arranged in a bottle train. Bottles in the train containing water uncontaminated with atmospheric oxygen were to be removed and processed as indicated in Appendix B, Table 1. Samples to be filtered anaerobically were to be vacuum filtered through acid-washed Millipore membrane filters under a nitrogen gas atmosphere. Preserved samples were returned to the laboratory at Auburn University for anlayses.

Results and Discussion

3. Dissolved oxygen concentrations on the three sampling dates never dropped below 1.0 mg/l; therefore, anaerobic sampling was unnecessary (Appendix B, Table 2). Results of analyses conducted are presented in Appendix B, Tables 3-6.

APPENDIX B

Table 1

Water chemical variables to be measured, sample collection, preservation and analytical methods to be used.

Variable	Sample Collection and Preservation	Analytical Method	Reference
Total iron	Anaerobic sampling. Acidify sample to pH <2 with HCl.	Atomic Absorption Spectrophotometry	SMEWW, p.144[1]
Dissolved iron	Anaerobic filtration through 0.1 u membrane filter. Acidify as above.	Same as above	"
Total manganese	Anaerobic sampling. Acidify sample to pH <2 with HCl.	Atomic Absorption Spectrophotometry	SMEWW, p.144
Dissolved manganese	Anaerobic filtration through 0.1 u membrane filter. Acidify as above.	Same as above	"
Ammonium nitrogen	Acidify with 2 ml conc. H_2SO_4/l and cool, 4^oC.	Phenate method	SMEWW, p.416
Nitrate/nitrite nitrogen	Filter through 0.45 μ membrane filter, cool 4^oC.	Cadmium reduction	SMEWW, p.423
Soluble reactive phosphorus (orthophosphate)	Anaerobic filtration through 0.45 μ membrane filter, cool 4^oC or freeze. pH <3, HCl.	Ascorbic acid method	SMEWW, p.481
Total phosphorus	Anaerobic sample collection. Acidify to pH <2 with conc. H_2SO_4. Cool, 4^oC in polyethylene container (may freeze).	Acid/persulfate digestion method Ascorbic acid method	SMEWW, p.466

1. American Public Health Assoc. American Water Works Assoc. and Water Pollution Control Fed. 1975. Standard methods for the examination of water and wastewater. 14th ed., Washington, D.C. 1193 pp.

APPEND'X B

Table 2

Temperature and dissolved oxygen concentrations of water samples taken at various locations and depths in West Point Lake on 5 August, 26 August and 24 September 1980.

Sta.	Depth m	5 Aug 80		26 Aug 80		24 Sep 80	
		°C	D.O. mg/l	°C	D.O. mg/l	°C	D.O. mg/l
A	0	--	--	--	--	--	--
	2	--	--	--	--	--	--
B	0	31.5	10.2	27.5	11.6	26.0	8.3
	2	32.0	8.7	27.0	11.5	24.0	6.0
	4	29.5	6.5	25.5	6.5	23.5	5.5
	8	28.5	5.5	25.5	6.5	23.5	5.4
	12	28.0	4.7	25.0	6.4	--	--
C	0	30.0	8.4	29.2	7.4	28.5	9.5
	2	30.0	6.7	29.0	7.4	28.3	8.8
	4	29.5	5.6	28.8	6.2	27.5	4.7
	8	28.5	1.8	28.7	5.4	27.0	3.7
	16	25.5	1.3	26.8	1.7	25.5	5.5
D	0	29.0	7.5	29.0	7.4	28.0	7.9
	2	29.0	7.6	29.0	7.3	28.0	7.6
	4	29.5	7.5	29.0	7.0	27.4	4.2
	8	29.0	4.8	29.0	5.0	27.0	1.6
	16	26.0	2.6	27.0	1.7	25.5	1.7
	24	25.0	1.6	26.0	1.8	26.0	1.8
E	0	27.0	4.4	28.0	4.4	26.0	4.0
F	0	30.5	7.0	29.2	6.0	28.0	7.5
	2	29.5	7.6	29.0	5.3	27.8	6.1
	4	29.5	5.9	28.8	3.8	27.3	2.3
G	0	32.0	8.6	29.0	8.3	28.5	9.1
	2	30.5	8.4	29.0	7.8	28.0	6.9
	4	30.0	8.2	29.0	6.2	27.0	1.3

APPENDIX B

Table 3

Ammonia and nitrite-nitrate nitrogen concentrations of water samples taken at various locations and depths in West Point Lake on 5 August, 26 August and 24 September 1980.

Sta.	Depth m	5 Aug 80		26 Aug 80		24 Sep 80	
		NH_3 ppm	NO_2&NO_3 ppm	NH_3 ppm	NO_2&NO_3 ppm	NH_3 ppm	NO_2&NO_3 ppm
A	0	0.196	0.609	0.067	0.607	0.091	0.564
	2	0.174	0.607	--	--	--	--
B	0	0.000	0.487	0.000	0.554	0.002	0.543
	2	0.000	0.454	0.000	0.577	0.049	0.623
	4	0.000	0.521	0.000	0.615	0.096	0.622
	8	0.000	0.598	0.000	0.600	0.055	0.628
	12	0.000	0.585	0.014	0.605	--	--
C	0	0.000	0.114	0.020	0.251	0.000	0.217
	2	0.000	0.134	0.007	0.274	0.000	0.292
	4	0.000	0.176	0.000	0.266	0.032	0.577
	8	0.000	0.477	0.000	0.524	0.011	0.629
	16	0.250	0.020	0.176	0.543	0.104	0.616
D	0	0.000	0.010	0.000	0.021	0.000	0.013
	2	0.000	0.011	0.000	0.019	0.000	0.015
	4	0.000	0.009	0.000	0.022	0.011	0.134
	8	0.000	0.031	0.000	0.084	0.016	0.335
	16	0.086	0.012	0.257	0.014	0.361	0.078
	24	0.206	0.010	0.446	0.007	0.470	0.032
E	0	0.022	0.099	0.203	0.061	0.120	0.236
F	0	0.000	0.014	0.000	0.015	0.011	0.015
	2	0.000	0.014	0.000	0.015	0.000	0.014
	4	0.000	0.016	0.000	0.019	0.033	0.015
G	0	0.000	0.013	0.000	0.041	0.000	0.018
	2	0.000	0.009	0.000	0.236	0.022	0.032
	4	0.000	0.013	0.027	0.483	0.120	0.463

APPENDIX B

Table 4

Ortho- and total phosphorus concentrations of water samples taken at various locations and depths in West Point Lake on 5 August, 26 August and 24 September 1980.

Sta.	Depth m	5 Aug 80 ortho P ppm	5 Aug 80 total P ppm	26 Aug 80 ortho P ppm	26 Aug 80 total P ppm	24 Sep 80 ortho P ppm	24 Sep 80 total P ppm
A	0	0.00031	0.00060	0.00022	0.00022	0.00028	0.00063
	2	0.00033	0.00060	--	--	--	--
B	0	0.00004	0.00020	0.00010	0.00024	0.00009	0.00035
	2	0.00008	0.00020	0.00008	0.00023	0.00019	0.00044
	4	0.00012	0.00020	0.00010	0.00028	0.00021	0.00045
	8	0.00015	0.00030	0.00026	0.00032	0.00021	0.00047
	12	0.00025	0.00030	0.00021	0.00034	--	--
C	0	0.00004	0.00013	0.00014	0.00018	0.00002	0.00030
	2	0.00004	0.00013	0.00003	0.00016	0.00001	0.00032
	4	0.00004	0.00012	0.00001	0.00014	0.00002	0.00051
	8	0.00006	0.00013	0.00002	0.00017	0.00004	0.00031
	16	0.00031	0.00040	0.00010	0.00019	0.00013	0.00037
D	0	0.00002	0.00014	0.00005	0.00016	0.00001	0.00021
	2	0.00002	0.00008	0.00007	0.00018	0.00001	0.00022
	4	0.00002	0.00011	0.00001	0.00017	0.00002	0.00023
	8	0.00002	0.00009	0.00019	0.00016	0.00002	0.00028
	16	0.00012	0.00022	0.00022	0.00024	0.00058	0.00035
	24	0.00021	0.00030	0.00006	0.00032	0.00056	0.00038
E	0	0.00006	0.00016	0.00003	0.00018	0.00003	0.00019
F	0	0.00003	0.00010	0.00005	0.00014	0.00001	0.00018
	2	0.00004	0.00012	0.00013	0.00017	0.00003	0.00014
	4	0.00003	0.00013	0.00002	0.00014	0.00003	0.00019
G	0	0.00004	0.00011	0.00001	0.00016	0.00003	0.00015
	2	0.00003	0.00012	0.00020	0.00017	0.00002	0.00016
	4	0.00013	0.00011	0.00002	0.00018	0.00003	0.00017

APPENDIX B

Table 5

Soluble and total manganese concentrations of water samples taken at various locations and depths in West Point Lake on 5 August, 26 August and 24 September 1980.

Sta.	Depth m	5 Aug 80 Sol.Mn ppm	5 Aug 80 Tot.Mn ppm	26 Aug 80 Sol.Mn ppm	26 Aug 80 Tot.Mn ppm	24 Sep 80 Sol.Mn ppm	24 Sep 80 Tot.Mn ppm
A	0	0.210	0.174	0.190	0.130	0.240	0.100
	2	0.130	0.235	--	--	--	--
B	0	0.130	0.160	0.140	0.100	0.210	0.150
	2	0.010	0.140	0.130	0.110	0.450	0.120
	4	0.190	0.200	0.160	0.140	0.140	0.130
	8	0.250	0.338	0.110	0.165	0.250	0.165
	12	0.240	0.338	0.110	0.160	--	--
C	0	0.045	0.250	0.019	0.035	0.260	0.075
	2	0.050	0.145	0.010	0.045	0.235	0.065
	4	0.060	0.220	0.019	0.045	0.170	0.090
	8	0.331	0.280	0.030	0.055	0.450	0.210
	16	2.300	1.550	0.360	0.325	0.310	0.270
D	0	0.000	0.225	0.045	0.035	0.070	0.130
	2	0.110	0.174	0.061	0.035	0.170	0.140
	4	0.060	0.230	0.045	0.040	0.045	0.120
	8	0.030	0.150	0.079	0.021	0.210	0.075
	16	1.050	1.030	0.790	0.735	1.230	1.220
	24	1.520	1.325	1.270	1.050	1.220	1.210
E	0	0.450	0.450	0.350	0.235	0.211	0.180
F	0	0.000	0.220	0.170	0.165	0.140	0.130
	2	0.000	0.270	0.190	0.160	0.125	0.200
	4	0.110	0.370	0.285	0.315	0.900	0.600
G	0	0.045	0.125	0.030	0.085	0.090	0.100
	2	0.070	0.370	0.061	0.080	0.130	0.150
	4	0.050	0.120	0.030	0.100	0.360	0.330

APPENDIX B

Table 6

Soluble and total iron concentrations of water samples taken at various locations and depths in West Point Lake on 5 August, 26 August and 24 September 1980.

Sta.	Depth m	5 Aug 80		26 Aug 80		24 Sep 80	
		Sol.Fe ppm	Tot.Fe ppm	Sol.Fe ppm	Tot.Fe ppm	Sol.Fe ppm	Tot.Fe ppm
A	0	1.05	2.78	0.71	0.66	2.65	1.60
	2	1.15	1.86	--	--	--	--
B	0	0.45	1.15	0.40	0.42	1.10	0.84
	2	0.35	1.34	0.85	0.40	>15.00	0.90
	4	0.25	0.84	0.80	0.45	1.35	1.50
	8	0.20	0.93	0.89	0.62	1.10	1.40
	12	0.35	1.46	0.92	1.04	--	--
C	0	0.20	0.59	0.55	0.25	>15.00	1.40
	2	0.40	0.93	0.50	0.40	>15.00	0.63
	4	0.25	0.70	0.20	0.30	1.35	0.32
	8	0.15	0.90	0.20	0.42	>15.00	0.49
	16	3.45	4.65	0.62	0.52	2.15	1.87
D	0	0.24	0.90	0.20	0.28	0.92	0.94
	2	0.35	0.59	0.00	0.25	1.40	0.79
	4	0.10	0.32	0.00	0.38	0.62	0.84
	8	0.39	0.90	0.10	0.20	>15.00	0.63
	16	2.00	14.80	3.40	2.30	9.30	9.60
	24	3.69	4.04	6.85	3.64	8.90	9.30
E	0	0.40	1.50	0.62	0.76	0.75	0.84
F	0	0.15	0.90	0.00	0.42	0.89	0.84
	2	0.30	0.84	0.00	0.45	0.89	0.84
	4	0.35	0.59	0.25	0.55	>15.00	11.40
G	0	0.39	0.38	0.10	0.40	1.20	0.84
	2	0.24	0.59	0.10	0.38	1.05	0.84
	4	0.24	0.42	0.10	0.40	4.95	1.50

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